The use of a virtual patient to simulate a pharmacist-patient anticoagulation consultation: a mixed methods evaluation

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Abstract

Introduction

Patients commencing new medications, particularly those that are high risk such as non-vitamin K oral anticoagulants (NOACs), require counselling to ensure safe, effective and empowering use of the medicine. Pharmacists are well placed to provide this counselling, but they require an underpinning ability to do so. Training on NOACs is unstandardised and variable. A virtual patient (VP) educational tool on the topic of NOACs has been developed to help develop counselling skills relating to NOAC use in atrial fibrillation. VPs have been used to provide training for undergraduate students, but they are largely uninvestigated for use by qualified healthcare professionals. This study aims to evaluate the VP application and explore perspectives of pharmacists and pre-registration trainees on its use and potential.

Methods

The study followed a sequential exploratory mixed methods design using a sample of pharmacists and pre-registration trainees from sites across England. The participants completed a questionnaire pre and post-VP use. Following an interim analysis, a sample of the respondents were selected to undertake a follow-up semi-structured interview. Questionnaire results were analysed using a mixture of descriptive and inferential statistics; qualitative results were analysed using the Framework approach to thematic analysis. Results were then integrated via triangulation and corroborated to give an overall interpretation of the findings.

Results and discussion

NOAC training appears to be an under provided for area with many participants lacking in confidence in conducting NOAC patient counselling. There was a significant average increase

in self-reported counselling ability across the respondents pre- to post-VP which suggests a benefit to VP use. The exact nature of the benefits were wide ranging and included changes in knowledge, confidence, contextualisation of content and an opportunity to practice. Some participants also cited effects of VP use on their practice, including using the learning as part of continuing professional development. Well recognised benefits to VP use were also further demonstrated including mobility and safety.

The VP was largely well liked, usable and acceptable as a learning resource, but some improvements could be made prior to wider implementation. This includes changes to the delivery of feedback and increased flexibility in responses within the VP. The study considered how VP use maps to the theory of experiential learning to provide a learning opportunity routed in andragogical theory. There was a discussion around different VP users with no single ideal group identified but rather multiple groups that could all benefit from VP use; pre-registration trainees and newly qualified pharmacists were the most favoured. Implementation of the VP needs to be more well thought-out with a clear strategy and considerations for the required supporting infrastructure. This supporting infrastructure needs to be developed to support sustained and useful use of the VP application.

Conclusion

This research has demonstrated value of the VP, both from an individual user and wider educational perspective. A number of improvements, developments and further considerations have been identified including things to be addressed prior to any further implementation. The VP application is a useful additional resource which should be considered when pharmacy professionals are undertaking education and training around NOACs.

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Contents

Publications

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Peer-reviewed Conference Presentations

Oral presentations

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Richardson CL, White S, Chapman S. (2018). Virtual patient technology, to teach clinical pharmacists NOAC counselling – A Pilot Study. The Great North Pharmacy Research Collaborative Conference in Association with Pharmacy Management. Newcastle Upon Tyne.

Poster presentations

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Richardson CL, White S, Chapman S. (2020). A virtual patient educational programme to teach counselling to clinical pharmacists - A quantitative evaluation. Prescribing and Research into Medicines Management Conference. Manchester. *Pharmacoepidemiology and Drug Safety*. [In Press].

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Richardson CL, White S, Chapman S. (2018). A Virtual Patient Educational Programme to Teach Counselling to Clinical Pharmacists. Prescribing and Research into Medicines Management Conference. London. *Pharmacoepidemiology and Drug Safety* 28:**S1**. 14-15.

Figures and Tables

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Abbreviations

AF – atrial fibrillation

C&D – Chemist & Druggist

CFIR – Consolidated Framework for Implementation Research

CINAHL – Cumulative Index to Nursing and Allied Health Literature

CPD – continuing professional development

CPPE – Center for Pharmacy Postgraduate Education

CRN – Clinical Research Network

DOAC – direct oral anticoagulant (see NOAC)

ERIC – Education Resources Information Center

ESC – European Society of Cardiology

FFI – face to face interview

GPhC – General Pharmaceutical Council

HCP – healthcare professional

HDAS – Health Databases Advanced Search

HMIC – The Health Management Information Consortium

IQR – interquartle range

MCQ – Multiple choice question

NHS – National Health Service

NICE – National Institute for Health and Care Excellence

NMS – new medicine service

NOAC – non-vitamin K oral anticoagulant, or novel oral anticoagulant (also see DOAC)

PICOS – intervention, comparison, outcomes, and study design

RCT – randomised controlled trial

SD – standard deviation

TI – telephone interview

VKA – Vitamin K antagonist

VI – video interview

VP – virtual patient

Foreword

Over fifteen years ago the Keele University School of Pharmacy developed its first virtual patient (VP). Initially these used remarkably limited technology based on still images of patients using inhalers, the technology evolved into more realistic computer-generated animations that respond to inputs of data to interact with users. The VP which formed the basis of this evaluation was commissioned by *Bayer AG* with the brief of using VPs to educate pharmacists on patient counselling for those with atrial fibrillation (AF) and taking non-vitamin K oral anticoagulants (NOACs), specifically rivaroxaban. *Bayer AG,* as the manufacturer of rivaroxaban (Xarelto©), commissioned and funded the development of the VP, they had no part in this evaluation.

Overview of the research

This research study evaluates the VP application using a sequential mixed methods design. This firstly involved a questionnaire which was mainly quantitative, using Likert scales. This was followed by a second semi-structured interview phase to further explore participant's perspectives on the VP. All participants took part in the questionnaire phase and then a sample of respondents were selected to take part in a follow-up interview. The two phases were connected in an intermediate phase where the questionnaire data were used to sample and recruit participants for interviews. Additionally, at the end of the study, the data from the two phases were integrated to give an overall interpretation.

Thesis structure

Each of the following chapters focuses on a particular aspect of the study as outlined below.

- Chapter 1 presents a background to the topic of the research study. This includes AF and NOACs, VPs and the educational context for the study.

- Chapter 2 presents an overview of the relevant literature of this study. This includes an exploration of VP definitions, the range of technologies used within multiple health professions, and various VP purposes and applications.
- Chapter 3 further reviews the literature specifically on the use of VP technology in pharmacy to teach communication or counselling skills. The review uses a narrative approach with a systematic search strategy.
- Chapters 4 and 5 explore the methodology and methods of the study respectively. The philosophical research paradigm, the instruments used and how this affected the study were key discussion points.
- Chapter 6 presents the questionnaire results with a brief discussion of the relevance of the findings.
- Chapters 7-9 present the interview findings, each focusing on one category of themes. Chapter 9 also includes a supplementary analysis focusing on the implementation of the VP. Each qualitative chapter includes a brief discussion of the interview findings relative to the study aim and objectives.
- Chapter 10 concludes with a wider discussion of the findings and an integrated interpretation of the findings of the two phases. This includes implications for practice and research recommendations.

1 Background

1.1 Introduction

Within this chapter the topics of AF, NOACs, patient counselling, and pharmacist education and training are discussed. The VP technology and the VP development process are also discussed. This includes the educational foundations of the VP and technological design. Definitions and assumptions relevant to the study are also highlighted.

1.2 Atrial fibrillation

AF is the most common sustained cardiac arrhythmia worldwide (National Institute for Health and Care Excellence 2014) and despite advances in treatment and management, AF remains a major cause of stroke, heart failure, sudden death and cardiovascular morbidity worldwide (Kirchhof *et al.* 2016). The prevalence of AF is increasing (National Institute for Health and Care Excellence 2014) and it has been identified that the lifetime risk for AF at 40 years of age is approximately 1 in 4 people (Heeringa *et al.* 2006). AF poses a massive public health burden, especially considering that some risk factors for AF are also increasing in prevalence, such as survival post-myocardial infarction (Lloyd-Jones *et al.* 2004). The overall prevalence of AF is 5.5%, increasing with age to 17.8% in those over 85 years. Prevalence is slightly higher in men than in women (Heeringa *et al.* 2006); it is estimated that an average patient with AF visits a doctor between 8 and 11 times annually regarding their condition (Heeringa *et al.* 2006). Doctors have rated AF as the second most difficult condition to manage in practice and the third most demanding (Aliot *et al.* 2010). This was for a number of reasons including the demand on time and the complexity of explaining AF to patients; more than one in four doctors stated that they did not have enough time to fully explain AF to patients (Aliot *et al.* 2010).

1.2.1 Pharmaceutical treatment of atrial fibrillation

AF is a significant risk factor for stroke and one aim of treatment is to reduce this by anticoagulating patients (National Institute for Health and Care Excellence 2014). The choice of anticoagulant can be complex due to their associated increased bleeding risk, but there are two board categories used in AF: non-vitamin K antagonists (NOACs), the focus of this study, and Vitamin K antagonists (VKAs), such as warfarin (National Institute for Health and Care Excellence 2012).

The choice of anticoagulant resides with the patient and prescriber but, in the U.K., The National Institute for Clinical Excellence (NICE) recommends treatment with one of apixaban, dabigatran etexilate, rivaroxaban or a VKA (National Institute for Health and Care Excellence 2014). Edoxaban, a more recently licensed NOAC, is also recommended for use in the European guidelines (Kirchhof *et al.* 2016) and by NICE in a separate technology appraisal (National Institute for Health and Care Excellence 2015a). Increasingly NOACs are being used as an alternative to VKAs, such as warfarin, due to a more desirable dosing regimen, less monitoring, and less medication and food interactions (Verdecchia *et al.* 2016).

1.2.2 Patient counselling

Detailed patient education incorporating medication and lifestyle advice is required in AF (Davis 2013) and NICE recommends providing patients with a personalised package of care with regards to their AF (National Institute for Health and Care Excellence 2014). This encompasses providing education on various aspects of AF including anticoagulant treatment. Anticoagulant education should detail: how to use the anticoagulant; the duration of treatment (where applicable); possible side effects of treatment and what to do if side effects occur; effects of other medications, food or alcohol on treatment; monitoring requirements; effects on dental treatment; pregnancy advice; effects on other activities, for example, sports

and travel; and when to seek medical help. All patients should receive an anticoagulant information booklet and an alert card (National Institute for Health and Care Excellence 2012).

The European Society of Cardiology (ESC) highlighted the need for patients to undergo education at each AF visit, including the need to discuss adherence and what to do in the case of missed doses (Kirchhof *et al.* 2016). Several practical implications of education around NOACs have been identified; as well as repeated education, there should be a specified follow-up schedule for patients starting NOACs, which can be shared between healthcare professionals (HCPs), including pharmacists (Heidbuchel *et al.* 2015). One study demonstrated that following counselling by pharmacists, patients had greater knowledge regarding warfarin treatment (Collins *et al.* 2014). The study demonstrated the importance of ongoing patient counselling and education regarding warfarin and despite not incorporating NOACs specifically it demonstrates a benefit of warfarin specific counselling by pharmacists.

1.3 Education and training of pharmacists

In the U.K. to become a registered pharmacist, students must complete an accredited four year Master of Pharmacy degree followed by one year of structured pre-registration training that encompasses meeting defined competencies and passing the pharmacist registration assessment (General Pharmaceutical Council 2011). After meeting these requirements an individual can join the pharmacist register and start to practise as a pharmacist.

There are many providers of post-registration pharmacy education and training and many pharmacists go on to do further qualifications such as independent prescribing or a post-graduate diploma. In addition to this, pharmacists are required to undertake a continuous process of education and training to better their practice and contribute to continuing professional development (CPD) (General Pharmaceutical Council 2018a). One of the main providers of educational resources is the Centre for Pharmacy Postgraduate Education (CPPE) who provide resources for pharmacy education and training (Centre For Pharmacy

Postgraduate Education 2017). Many employers or organisations also organise and provide in-house education and training but, ultimately pharmacists are responsible for their own competence and practice in line with requirements set by the General Pharmaceutical Council (GPhC) to conduct CPD and revalidation annually.

1.3.1 Continuing professional development

It was anticipated, during the conception of the VP, that the VP application could have a role in CPD as well as the general education and training of pharmacists. The GPhC state that CPD must reflect the context and scope of a pharmacist's personal practice and must contribute to the quality or development of such (General Pharmaceutical Council 2010).

It was demonstrated in one study that over 90% of pharmacists were in favour of undertaking CPD to better their practice (Bell *et al.* 2001), with many citing that undertaking CPD would make them more confident and professional when interacting with patients (Bell *et al.* 2001). Despite this, a key obstacle found was the type and lack of resources available (Bell *et al.* 2001), signifying the need for a wider range and availability of CPD resources.

1.3.2 Communication and counselling skills

The GPhC states that one of the four main responsibilities of a pharmacist is *''advising patients about medicines, including how to take them, what reactions may occur and answering patients' questions''* (General Pharmaceutical Council 2018b). It is on this basis that a pharmacist must be appropriately trained to conduct medication counselling. Learning the principles of patient interactions and counselling is undertaken at undergraduate level, and in many cases this includes related assessments (General Pharmaceutical Council 2011). As these skills need to be constantly developed, they need reinforcing to be maintained (Burnard 2005). Pharmacists need a high counselling ability and with new medications constantly being

brought to the market it is essential they can apply the generic skills of patient interactions and counselling to new scenarios and drug-specific content.

There are few studies considering long-term counselling ability in pharmacists; one study investigated the longevity of pharmacist inhaler counselling and demonstration techniques, concluding that pharmacists need effective tools and encouragement to maintain their competency in inhaler counselling in order to best provide patients with the information that they need (Basheti *et al.* 2009). Another study from Finland found that a continuing education programme that promoted counselling was of benefit to pharmacists, particularly concerning approaches to, and implementation of, counselling (Kansanaho *et al.* 2003). Although these findings have not been established in the context of anticoagulant counselling it is suggested by the authors that resources to teach and reinforce particular counselling skills may be beneficial (Kansanaho *et al.* 2003, Basheti *et al.* 2009).

1.3.3 AF and NOAC training

Few anticoagulant and AF specific training or resources are available: CPPE provides online training for anticoagulant and antiplatelet medications intended to relate to the New Medicines Service (NMS) (Pharmaceutical Services Negotiating Committee 2013). *Bayer AG*, as the manufacturer of rivaroxaban, provide information for pharmacists on its use which includes some patient counselling requirements, but again this focuses on the NMS requirements (Bayer 2017). The two cited resources both provide factual information and do not give any indication as for the use of this information in real-life consultations other than meeting the NMS requirements. Other tools available include local-level resources, formal teaching sessions, journal pieces, and publications by organisations such as The Royal Pharmaceutical Society (The Royal Pharmaceutical Society 2012, 2017). These resources appear to vary immensely by location, method of delivery, and audience with no widely recognised ‘gold standard’ for NOAC counselling training, this is further explored in section

6.3. No resources using VPs have been identified to train pharmacists on the use of NOACs (chapters 2 and 3).

1.4 Educational context

1.4.1 Pedagogy, andragogy, and learning

Pedagogy, by definition, concerns the teaching of children (Holmes and Abington-Cooper 2000, Chan 2010), whereas, andragogy specifically concerns the teaching of adults or the process of helping adults learn (Clapper 2010, Zigmont *et al.* 2011). The latter term was first detonated by Knowles in the 1960s (Clapper 2010) and the discussion of pedagogy versus andragogy is debatable as some believe that there is no difference educationally between adults and children but others dispute this (Knowles 1980, Holmes and Abington-Cooper 2000, Chan 2010). Zigmont *et al.* (2011), argued that there is a distinct difference between child and adult learners on the basis that adults are: self-directed and regulated, intrinsically motivated to learn, and have previous knowledge and experiences that are a resource for learning. According to the author, these are not applicable to child learners. This is in line with other works by Clapper (2010). Furthermore, it has been suggested that when teaching adults compared to children, an educator moves away from being a 'teacher' to a 'facilitator' (Zigmont *et al.* 2011). Within this study, for the purpose of consistency, andragogy will be the term used as the VP is aimed specifically at adult learners. Some studies use the term pedagogy; this will be discussed where relevant.

A challenge for educators when creating a meaningful learning resource for adults is that learning should activate relevant previous experiences and knowledge, in order to allow the exploration of new and old alike (Zigmont *et al.* 2011). One way of doing this is through reflective based learning where experiences are recognised to play a significant role in learning (Zigmont *et al.* 2011). Using this method of learning it is not during the experience itself where the learning occurs but afterward during reflection and debriefing which are keys stages in the

learning process (Zigmont *et al.* 2011). For adults to change their daily practice on the basis of learning, the learning methods and the working environment must support the change and incorporate principles of life-long experiential learning (Zigmont *et al.* 2011). On the basis of this, it is clear that any new educational resource, including VPs, need to have a strong foundation in educational theory so that they can become useful learning experiences for the users.

1.4.2 Experiential learning and simulation

There are many different educational theories associated with both teaching HCPs and using technology to do so. A brief description of one of the most commonly used educational theories regarding experiential learning is presented below, this is adopted throughout the study.

Experiential and exploratory learning involves learner-driven investigations, this is often in pursuit of a real or simulated task (Rieman 1996). This is the opposite of more traditional methods of learning involving precisely determined tasks and resources that control learning (Rieman 1996). It is the incorporation of real tasks that makes simulation particularly well suited to this type of learning. Simulation and experiential learning are also well matched because users are in an active learning environment where they are able to formulate their own learning through inquiry, problem-solving and discovery (Njoo and Jong 1993).

Learning using simulation, compared to lecture-based or teacher-led learning, requires the application of knowledge to a situation, this puts users in control and can help refine mental models of a task or experience (Zigmont *et al.* 2011). Simulation also allows the user to self-regulate their own learning and there is a focus on personal learning objectives (Zigmont *et al.* 2011). But, in order for simulation to be a useful experience, a level of knowledge regarding experiential learning is required by the simulation facilitators and designers (Zigmont *et al.* 2011).

Kolb's experiential learning cycle (Figure ***1.1***) (Kolb 1984) lends itself to learning using simulation because the stages of the cycle fit well with stages and principles of simulation. This includes concrete experiences to help identify knowledge gaps, and, reflection and debriefing, thus allowing reflection and preparation for learning to occur (Zigmont *et al.* 2011, Poore *et al.* 2014).

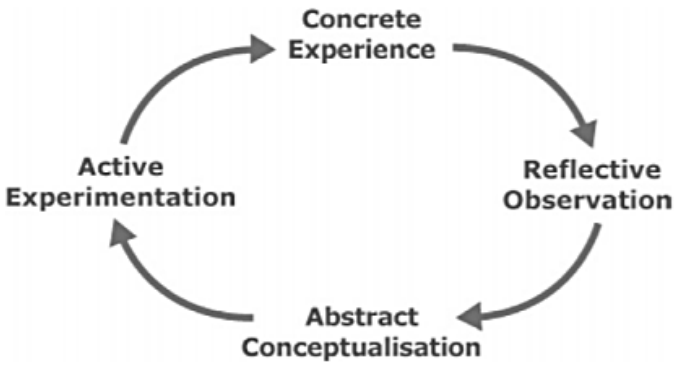

Figure 1.1 Kolb's experiential learning cycle taken from Zigmont et al. (2011)

Poore *et al.* (2014), directly mapped the stages of simulation to Kolb's learning cycle (Figure ***1.2***). The study specifically considered interprofessional education (IPE) in nursing but the general stages of simulation are the same across health professions and applications. Concrete experience is the point at which the initial simulation occurs. This is followed by reflection and abstract conceptualisation of the experience which helps to bridge learning to future experiences. At this stage, the learner's mental models can be changed on the basis of what has been learned. Finally, active experimentation involves the learner testing their new mental model this can either be by repeated simulation or a different experience such as experiences occurring in practice (Zigmont *et al.* 2011, Poore *et al.* 2014). It is using Kolb's theory of experiential learning and the map of this to simulation-based interventions that the VP educational application in this evaluation is based.

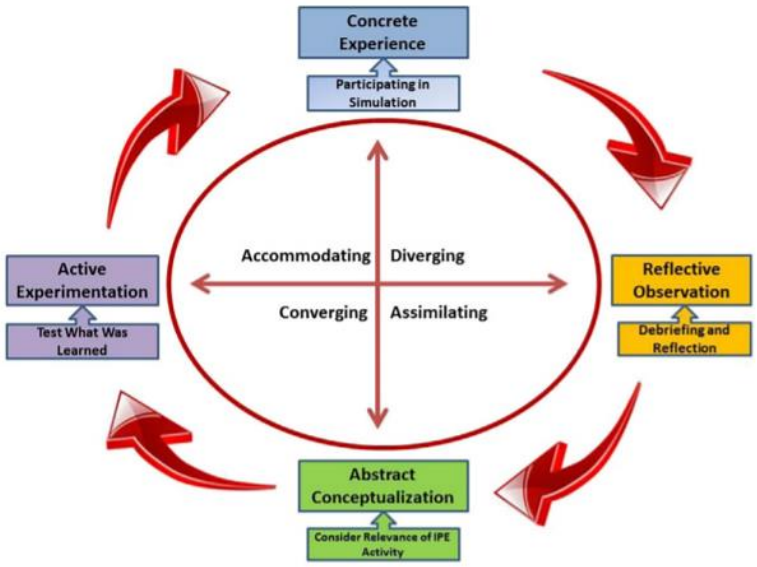

Figure 1.2 Kolb's experiential learning cycle mapped to the stages of simulation (Poore et al. 2014)

1.4.3 Mobile learning

Mobile devices are increasingly common and many researchers and educators are incorporating the use of mobile devices into teaching and learning environments (Park and Tech 2013). Similar to the use of simulation as an educational technique, learning using mobile devices needs to have a solid foundation of learning theory in order to become a useful learning experience (Park and Tech 2013).

Mobile learning can be defined as using a mobile or wireless device for the purpose of learning (Park and Tech 2013). Using this definition, this can include mobile phones, tablets, and laptops which are the three platforms that the VP of this study can be accessed through.

Multiple studies have considered mobile learning to be an extended or more sophisticated version of e-learning which is broadly any learning using an electronic medium (Traxler 2005, Park and Tech 2013). Mobile learning is recognised to be able to both provide uniquely situated or context-aware learning, and also conventional learning through a different medium, a named example being delivering learning to remote or inaccessible learners

(Traxler 2005). Other advantages of mobile learning are that it can be used by users who are on the move (Sharples *et al.* 2005).

Mobile learning embraces that a significant amount of learning is already taking place outside of classrooms and formal teaching establishments, and so it utilises this to deliver education (Sharples *et al.* 2005). This education is also often delivered in a more convenient way and mobile learning can bridge the gap between a learning environment and the environment where the learning is applied such as clinical practice (Sharples *et al.* 2005).

One study explored how the characteristics of learning and technology converge together to make learning useful (Sharples *et al.* 2005). In order for learning to be useful it should be personalised, learner-centered, situated, collaborative, ubiquitous and lifelong. Mapping almost directly on to this, the authors stated that technology can be: personal, user-centered, mobile, networked, ubiquitous and durable (Sharples *et al.* 2005). This is key, as it demonstrates the relevance of technology for learning as many of the characteristics overlap and thus it is logical to utilise technology for learning. Sharples *et al.* (2005), further explored the theory behind mobile learning and suggested asking five key questions of mobile learning resources (Figure ***1.3***). This is something that will be considered in the evaluation as the VP is a mobile-simulation learning resource. Sharples et al. (2005) discussed that it is the user who is mobile rather than the technology and learning should be interwoven as part of daily life, learning can generate as well as satisfy goals, and finally, mobile learning can both complement and conflict with formal education (Sharples *et al.* 2005). These ideas will be incorporated into this evaluation.

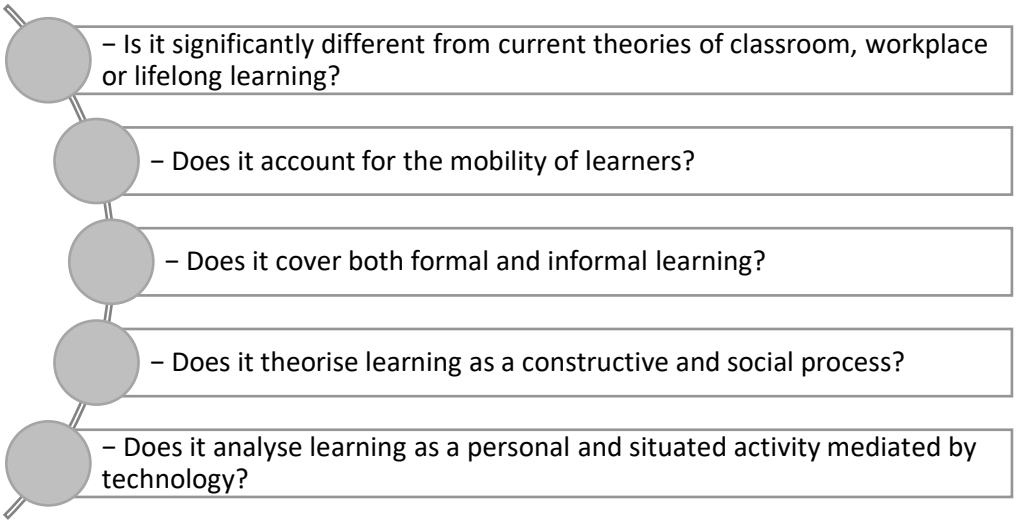

Figure 1.3 Five questions to evaluate mobile learning resources (Sharples et al. 2005)

Mobile learning is relevant to simulation-based learning as a common theme within the two is context (Sharples *et al.* 2009). Mobile learning allows learning to occur in a relevant environment by providing a virtual, but stable, context for learning. This can make the learning more relevant for the user as stability is still present but in a more contextualised manner (Sharples *et al.* 2009). Experiential-based learning is also interlinked to this as mobile learning can provide experiences for learning that are more closely related to practice as part of the learning cycle (Sharples *et al.* 2009). Importantly mobile learning does not take away from more traditional methods but as summarised by Sharples *et al.* (2009): *''Mobile learning offers new ways to extend education outside the classroom, into the conversations and interactions of everyday life.''* (Sharples *et al.* 2009). Mobile learning is important to this study as the VP can be accessed through a range of mobile devices and the implications for this will be considered within this evaluation.

1.5 The virtual patient

The VP application uses an animated patient within an interactive computer programme to simulate a pharmacy consultation. The patient, 'Henry Gentle', has been newly started on

rivaroxaban, a NOAC, for AF and he presents to his community pharmacy with his new prescription. The user takes on the role of the pharmacist to interact with the patient. The case progresses with the intention of providing a realistic representation of a NOAC consultation. The VP aims are to teach pharmacists how to counsel patients on NOACs for AF, to improve their own knowledge and ability and to contribute to their professional development. The development of the VP was previously reported (Richardson *et al.* 2018) and the design of the application is discussed below.

1.5.1 The technology

Broadly speaking, the VPs that are developed at Keele School of Pharmacy are designed around a clinical decision pathway with integrated visual effects. A virtual character responds to the user's decisions, with personalised user feedback at the conclusion of the case to enhance clinical decision making and counselling skills. This VP consists of computer-generated, animated, VP videos that depending on the decision made, trigger a relevant animation. The systems use *Hypertext Mark-up Language* (HTML), *cascading style sheets* (CSS) and *JavaScript* resource accessing video renders that allow the VPs to work on smartphones, tablets, and desktop devices (Figure ***1.4*** and Figure ***1.5***). This is in line with a previous research recommendation for VPs using more sophisticated graphics and animations (Jabbur-Lopes *et al.* 2012).

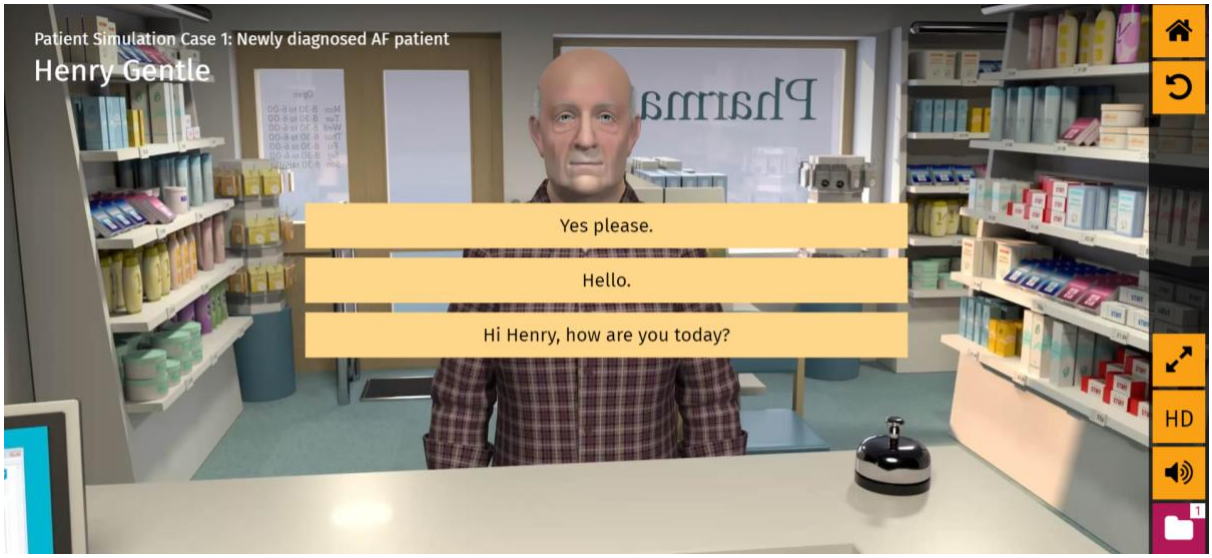

Figure 1.4 The VP interface accessed from a laptop running Google Chrome

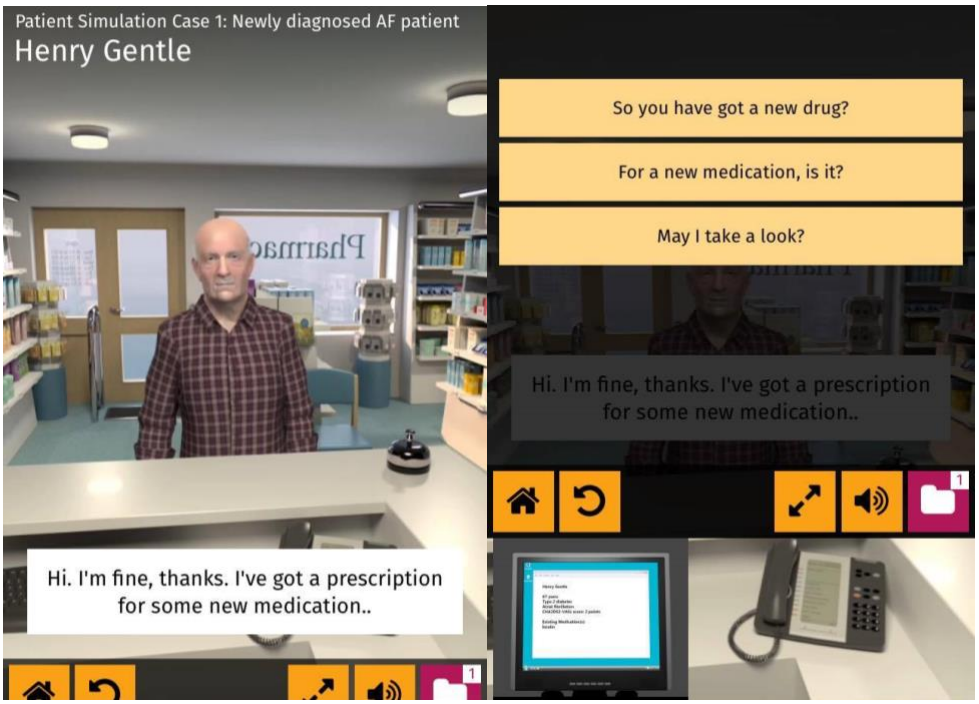

Figure 1.5 The VP interface from a smart mobile phone

The VP is accessed via a purpose-built website that can be used on an electronic device connected to the internet, the interface adapts to screen size of the device being used. The VP team at Keele University stated that the chosen technology had benefits based on the technology's ability to be updated, its adaptability and looking to the future, the technology's

potential for incorporating aspects not achievable in reality. These characteristics are supported by other studies that discussed the advantages of VPs (Bracegirdle and Chapman 2010, Tan *et al.* 2010, Douglass *et al.* 2013).

1.5.2 The avatar

Each avatar, or visual character, for each VP application, is carefully constructed to a specific design. Characteristics that can be tailored to create a unique character include facial features, age, gender, expressions, hair, clothes, and ethnicity. For some VP cases, patient characteristics will impact the case outcome and they need to be carefully considered.

In this case, Henry Gentle is described as a 67-year-old man and this was in keeping with the visual appearance of the avatar, his age and ethnicity are not specific to the outcome of the case but reflect common demographics of patients with AF. The VP's verbal responses are audio-recordings utilising the skills of a voice actor. The chosen voice actor is usually a close a match to the avatar's characteristics; Henry's voice actor was a similar age and ethnicity to him.

1.5.3 Application development

Every VP application is individually designed for a particular purpose and client and application details are precise; this can include elements such as the patient characteristics and script to the type and nature of feedback. Five proposed phases for VP development were loosely adopted during the development of this VP (Guise, Chambers, Conradi, *et al.* 2012). Phase one involved explicitly defining learning outcomes; phase two concerned concepts and designs; phase three technical design aspects and; phases four and five a cycle of evaluation and improvement (Guise, Chambers, Conradi, *et al.* 2012). The technology-orientated VP development team at Keele University led a three-way approach where the development

team, client, and a steering group informed VP development as part of the development process.

Development of the VP first involved the concept of the VP being discussed with the development team who developed a prototype using a basic script with stationary and incomplete characters. Following the modification and approval of this, a functional prototype was developed to test the script and scenario further. After approval of this, a fully functional version was developed.

1.5.4 Learning outcomes

The VP team requested the client to outline the VP's indented learning outcomes, this was to '*learn how to counsel a new patient on rivaroxaban'* (Figure ***1.6***). There was a further list of topics required to be covered in the scenario to ensure an application was created that included particular elements, a named example being, specific drug information such as, how to take the medication. The learning outcome and topic list helped with the development of the scenario script to meet the specific requirements of the client. The script was developed by the design team in conjunction with the client so that the application met both the client's expectations and the technological abilities of the software. This was particularly important when the client suggested ideas that were not possible or were difficult to achieve technically. The learning outcomes and topic list were rewritten a number of times during development to facilitate this.

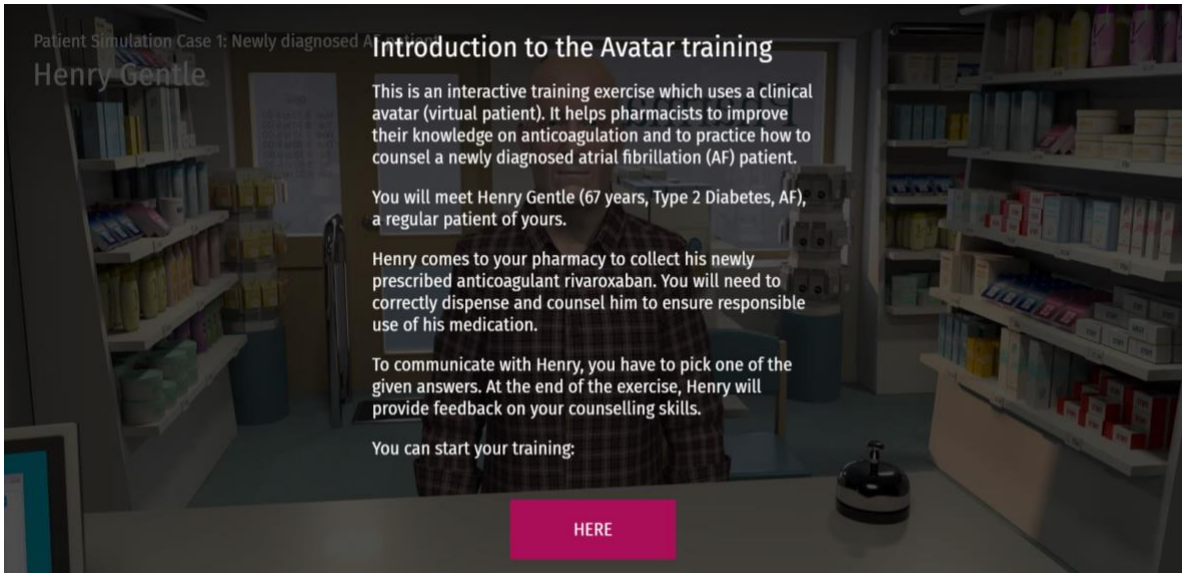

Figure 1.6 The VP application introduction as presented to the user

1.5.5 Decision tree and script

Once the scenario had intended learning outcomes, a decision tree of the script was developed. This simplified the case, detailing it from start to finish, helping to establish key points and decisions. Each question and/or action was carefully incorporated into the decision tree, with considerations for how individual elements could impact the case pathways moving forward within the application and also how decisions affect user feedback. The decision tree had approximately 40 questions and 90 elements that were highlighted as 'good' and 'bad' decisions relevant to the intended learning outcome. Each decision was categorised as more or less favourable compared to the optimum case pathway. The optimum pathway through the case was developed first before the addition of alternative routes, this is in keeping with the usual method for developing a decision tree (Guise, Chambers, Conradi, *et al.* 2012). The decision tree also highlighted the points within the case when additional information became available to the user, for example, access to the patient's medication record. The decision tree evolved throughout development until feedback in the development process suggested that the case pathways were ready for use; this process was an iterative development process led

by the expertise of the development team and steering group. No specific verification processes were used and this could have introduced bias from the developers in to the decision tree. Although this is a limitation of the development process this evaluation has taken place outside of the original development team and so any limitations identified can be reported to the developments; further specific considerations for bias within the decision tree may be required but is outside the scope of this evaluation.

1.5.6 Question design

The type of questioning within the VP case was also considered in some detail. VPs, generally, use either multiple choice questions or free text questioning. The former allows the user to select the most appropriate option from a list of a few, this appeared to be a commonly adopted approach and it was the method used in this VP (Pereira and Cavaco 2014, Moule *et al.* 2015, Zlotos *et al.* 2016). The later design appeared to be less common; it was used in the work by Stevens *et al.* (2006). A third questioning design makes use of both methods: the user types a keyword and a selection of related questions appear. This has been used in the medicines use review (MUR) work by Keele School of Pharmacy (Keele School of Pharmacy 2017) and the work by Bracegirdle and Chapman (2010).

This VP used multiple-choice questioning and although this can be less flexible for users it made the case technologically easier to develop. Additionally, multiple-choice questioning is recognised to be suited to narrative VPs with andrological influences of reflection-based learning through practice (Bearman *et al.* 2001), such as in this VP where users are encouraged to reflect on their performance.

1.5.7 User feedback

User feedback can vary depending on the design and purpose of the particular VP (Guise, Chambers, Conradi, *et al.* 2012). Examples include verbal or written feedback and some

systems give comprehensive feedback whereas others intentionally limit it for educational purposes (Zary *et al.* 2006). VP programmes can also grade the user's attempt or incorporate a pass/fail system as the design requires (Douglass *et al.* 2013, Taglieri *et al.* 2017).

Actions within this specific VP scenario triggered positive and negative feedback and at the end of the case personalised feedback was collated. Henry verbally delivered this feedback to the user, giving the impression that the patient was talking to the user, as the pharmacist, detailing what they did well and what could be improved (Figure ***1.7*** and Figure ***1.8***). Feedback was instantaneous after case completion which was intended to contribute to usability. The VP did not incorporate a user assessment such as a test because this was not in keeping with the exploratory and reflective purpose of the VP.

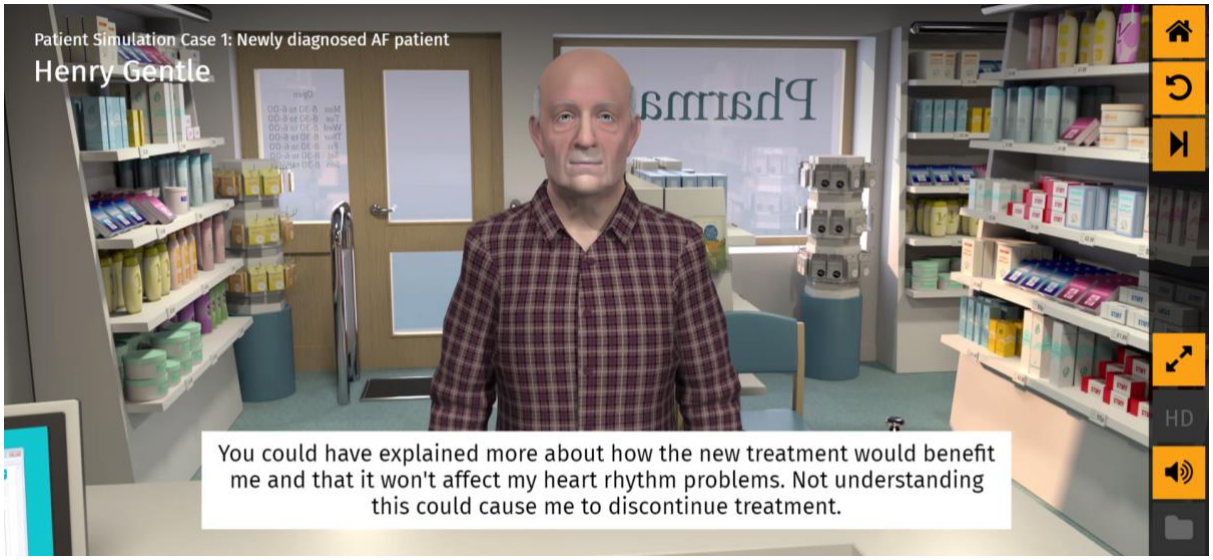

Figure 1.7 Feedback at the end of the application, Henry verbally provides feedback alongside subtitles

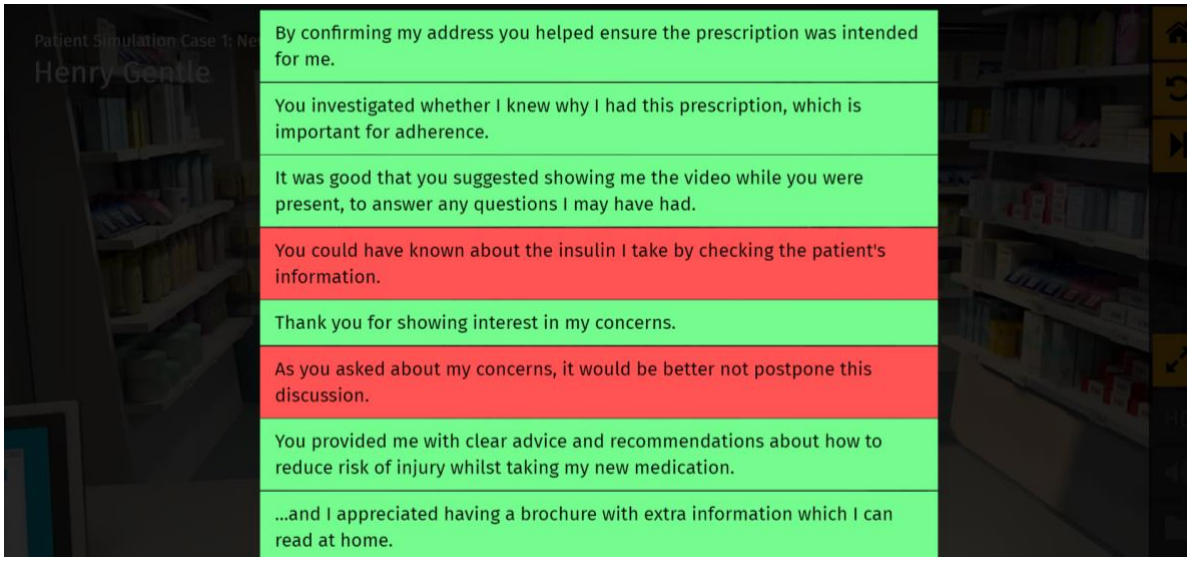

Figure 1.8 Downloadable and printable feedback at the end of the application

1.6 Research design

This research study aims to evaluate the use of the VP educational application described across section 1.5. VPs, although not a completely novel technology, are still being established in health professions and the purpose of this study is to evaluate this specific pharmacy VP application. As part of this, there is an emphasis on considerations for pharmacy practice and the future use of the VP. As already discussed, AF is one of the most difficult conditions to manage in practice (Aliot *et al.* 2010) and the VP may have consequences for patient education. There are few VPs are currently integrated into practice or education (chapter 2) and so this evaluation may help to encourage the integration of novel technologies into healthcare.

1.6.1 Assumptions and limitations

The study assumes that the participants, as pharmacy professionals, are competent to carry out patient consultations generally and to a degree on the topic of NOACs. A core premise of a pharmacist's role is to counsel patients on their medications and thus a degree of training and experience has been assumed. Pharmacists are responsible for their own competence and

professional development and so it is their own responsibility to ensure that they are competent to conduct medication counselling. The same is true of pre-registration trainees but to a lesser degree.

Pre-registration trainees are included throughout the study in addition to pharmacists; they are an individual in the interim year between graduating from university and joining the pharmacist register. During this year students are an intermediary between qualified HCP and student with the intention of further in-practice training and education. They should be equipped with general knowledge and skills of consultations but as they are still in a teaching and learning role, they may have less drug-specific knowledge and experience in practice. A level of generalisability between pharmacists and pre-registration trainees is assumed within the study as although the latter are not yet fully qualified, they are still governed by the GPhC and a code of conduct. Relevant differences and similarities between the two groups will be highlighted throughout the study.

The study also assumes that participants have some prior knowledge of NOACs. There will have been varying degrees of knowledge, partially due to different roles and experiences, nevertheless, the VP assumes a low knowledge level.

Non-vitamin K oral anticoagulants (NOACs) until recently, were also known as *novel* oral anticoagulants so may be referred to as such in the literature. They may also be referred to as *direct* oral anticoagulant or DOACs (Heidbuchel *et al.* 2015). In this study, the term NOAC is used as this appeared to be the more well-used term and the one adopted in the European and NICE guidelines (National Institute for Health and Care Excellence 2014, Heidbuchel *et al.* 2015).

1.6.2 The research team

This research contributes to a Ph.D. thesis in pharmacy education. The author, CR, completed a four-year Master of Pharmacy degree at Keele University graduating with First class honours

in 2016. Following this, they completed pre-registration training at The James Cook University Hospital, Middlesbrough and qualified as a pharmacist in 2017. The author started their Ph.D. in September 2017 and they also worked as a locum pharmacist in this time. In the last year of the research study the author worked as a lecturer of pharmacy practice and work-based learning at Newcastle University School of Pharmacy.

2 Overview of the literature

2.1 Introduction

Patient counselling has a pivotal role in allowing pharmacists to identify and solve drug-related problems and can empower patients to adopt positive self-management of their medical conditions and medicines (Pereira and Cavaco 2014). Counselling has also been shown to increase patient satisfaction and optimise patient quality of care (Pereira and Cavaco 2014).

This chapter presents an overview and background to the body of literature detailing the uses of VPs in healthcare, VP characteristics, and VP purposes. There is a discussion of simulation technology as a wider concept, followed by dialogue around VPs specifically, focusing on their design and theoretical foundations. This chapter aims to provide context for the systematic narrative review that follows. The role of the proposed research is continuously conferred considering gaps and inconsistencies in the literature to identify where the VP evaluation will provide new insight.

2.2 The simulation spectrum in health education

Simulation as a means of education was first conceived in aviation where it is well ingrained within the sector to improve safety and quality (Lin *et al.* 2011). Simulation in healthcare is a newer concept but one that has been growing, it can be defined as:

> *''an educational technique that allows interactive, and at times immersive, activity by recreating all or part of a clinical experience without exposing patients to the associated risks''* (Maran and Glavin 2003).

Simulation has many recognised advantages which include reduced undesired interference from external influences; the ability for scenarios to be created to demand; the ability for skills

to be repeated and practiced; the capability to tailor training to individuals; and enhancement of the transfer between the classroom and clinical environments (Maran and Glavin 2003). A further advantage is that of patient safety, as the use of simulation removes or reduces risks to the patient (Maran and Glavin 2003). Simulation can be used to build confidence and it has been shown to help achieve a faster time to competence than traditional methods (Lin *et al.* 2011). It is not intended to replace learning in clinical environments but it can be used to prepare for and enhance clinical experiences (Maran and Glavin 2003).

There are some disadvantages to simulation which include, depending on the specific technology: limited realism; limited humanistic features such as emotion; the need for spatial and financial recourses; a questionable return on investment; and the requirement for full user participation and engagement (Lin *et al.* 2011). Some simulation technologies have also reported difficulties in recreating facial expressions and subtle clinical clues (Maran and Glavin 2003).

Simulation encompasses a spectrum of technologies which can be separated or categorised in a number of ways. One of the most common methods of categorisation is on the basis of fidelity, which is the ability of the system to replicate a task or scenario. Maran and Galvin used this to discuss the range of simulation in health. This included: high fidelity mannequins or task trainers such as *Harvey*; computer-based systems; virtual reality systems; VPs; simulated environments and integrated combinations of multiple methods (Maran and Glavin 2003). The remainder of this narrative will focus on VPs as one sub-type of simulation, where relevant references to other sub-types will be made.

2.3 Virtual patient technology

Within healthcare simulation, VPs are one sub-type of simulation and their use, until recently, has largely been peripheral (Ellaway *et al.* 2009). VPs have only entered mainstream medical education in recent years and this may be due to some of the previous barriers to VP adoption

having been overcome (Ellaway *et al.* 2009). Named examples of this include an increasing awareness of the ability of VPs to pose scenarios that are obscure or missed during practice or placements; a better understanding of the underlying technology of VPs; and an increasing appreciation for the pedagogical and andragogical value of alternative educational modalities (Ellaway *et al.* 2009). This is suggested to have contributed to a somewhat increased implementation of VPs (Ellaway *et al.* 2009). Conversely, there does appear to be a lack of consistency that allows VPs to be reused outside of their original context, consequently generalisability is an increasingly significant factor when evaluating VPs (Georg and Zary 2014).

VPs are thought of as an alternative to more traditional simulation techniques, particularly standardised patients, which are actors used to simulate patient-professional interactions. Some literature suggests that VPs are as effective or have benefits over standardised patients (Stevens *et al.* 2006, Ellaway *et al.* 2009, Baumann-Birkbeck *et al.* 2017), and additionally standardised patients have some distinct disadvantages which can be overcome or reduced by using VPs. They are expensive, in terms of time and resource, and variability has been shown regarding training and outcomes (Stevens *et al.* 2006), a phenomenon known as performance drift (Baumann-Birkbeck *et al.* 2017). VPs, especially when used for assessments, can be more standardised than standardised patients and they have the ability to replicate scenarios that are difficult to duplicate with standardised patients (Stevens *et al.* 2006). Notable examples of this include aggressive patients or paediatric consultations. VPs allow for repetition and mistakes without consequence, even more so than with standardised patients (Stevens *et al.* 2006).

VPs specifically have a number of advantages, including their potential to deliver education to large numbers and at a relatively low cost (Bateman *et al.* 2013); they can easily incorporate assessments and they have an efficient delivery that can be anywhere, anytime and is learner-centred (Tan *et al.* 2010). Despite this, VPs are not without disadvantage: using VPs can be a learning curve for users and facilitators; VPs require a level of technology or equipment to be

available and functioning in order to be beneficial; and costs can be significant to develop and set up a VP; VPs are a rapidly evolving technology and programmes have to be kept up to date with a level of constant maintenance (Tan *et al.* 2010).

2.3.1 Classifications

VP definitions vary remarkably, and this can result in confusion and so some authors use classification systems rather than overt definitions. Cook and Triola (2009) suggested that VPs are made up of all or a combination of the following: *interactivity, clinical requests and responses, case progression, feedback and instruction, learner collaboration, curricular integration, and assessment*. Although this is a vague description that could encompass many simulation technologies not solely VPs.

One review sought to clarify the confusion by classifying VPs into categories based on their purpose: *education, clinical procedures, clinical research and eHealth* (Kononowicz *et al.* 2015). From the searches, around 500 studies were retrieved. Educational VPs were the most common group (62%); with interactive patient scenarios accounting for 37% of this group, followed by high fidelity simulations and virtual standardised patients (a VP by definition of this study, as discussed in section 2.3.2). Less frequent categories included VP games. The categories relevant to this study were interactive patient scenarios and virtual standardised patients, which have the predominant competencies of clinical reasoning and communication skills respectively. A drawback of the classification was that some types of VP could not be classified and so were excluded, somewhat limiting the inclusion criteria. The review used a deductive approach to analyse the programmes, this included descriptive statistical analyses. The findings indicated that the quantity of VP technologies increased between 1991 and 2013; interactive patient scenarios increased rapidly but virtual standardised patients were lower and more constant, this suggests that 'virtual standardised patients' or VPs, were not as widely researched in this time frame (Kononowicz *et al.* 2015).

A similar research study to the one previously discussed also attempted to define and categorise VPs, 185 definitions of VPs underwent inductive-deductive analysis to establish definition categories: *patient, teacher, VP, curriculum, and learner* (Hege *et al.* 2016). Sub-groups were defined, and notable examples included interactivity, feedback, and authenticity; these were visualised in a concept map which presents a comprehensive view of VPs (Figure ***2.1***). This framework is simpler than work by Kononowicz *et al.* (2015) but it presents some new and alternate ideas, such as the patient being a stakeholder in VP development. This does not appear to be discussed elsewhere in the literature, but it is something to be considered in the future. The authors suggest the need for further research investigating the perceived authenticity of VPs and how this affects learner engagement (Hege *et al.* 2016).

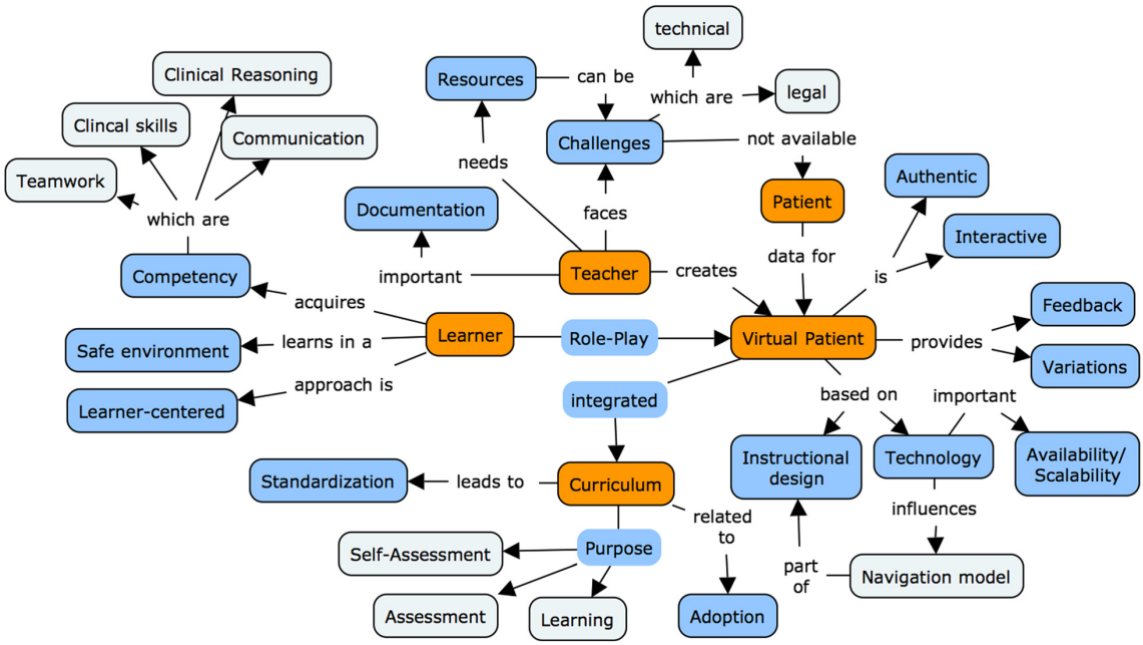

Figure 2.1 A concept map of a framework for VP design. The colour coding represents the different layers of VP descriptions where the five orange descriptors represent the five types of VP as concluded by Hege et al. (Taken from Hege et al. 2016)

2.3.2 Definitions

The definition of VPs can vary remarkably and, for the purpose of this study, three of the most cited definitions are critiqued before discussing the study's adopted definition. The American Association of Medical Colleges (AAMC) define a VP as:

> *''A specific type of computer-based program that simulates real-life clinical scenarios; learners emulate the roles of health care providers to obtain a history, conduct a physical exam, and make diagnostic and therapeutic decision''* (Association of American Medical Colleges 2007).

Numerous studies have adopted this definition including Kononowicz *et al.* (2015), but it is most relevant to the medical profession as the definition states that a VP must incorporate four components of history, physical exam, diagnosis, and therapy. This may not always be applicable to all VP applications, especially those aimed at pharmacy professionals. The AAMC definition is not adopted because of this.

A second definition is that of Ellaway *et al.* (2007), who state a VP is:

> *''An interactive computer simulation of real-life clinical scenarios for the purpose of medical training, education, or assessment. Users may be learners, teachers, or examiners.''* (Ellaway *et al.* 2007).

This definition is more relevant to this study as it is less restrictive and could include VPs which are used to train HCPs a range of skills and knowledge. It does not stipulate a profession, design or andragogical intent. A planned Cochrane review also adopted this definition (Kononowicz *et al.* 2016).

A final definition is that of Bracegirdle and Chapman (2010), who defined a VP as:

> *'A computer generated programmable patient, or avatar to simulate a clinical scenario in a three dimensional environment. The character or avatar responds to the decisions made by the learner'* (Bracegirdle and Chapman 2010).

The work by Thompson *et al.* (2016), adopted this as did Cavaco and Madeira (2012). Similar to Ellaway *et al.* (2007), there is no restriction on the nature of the technology and the definition is broad.

The definition by Bracegirdle and Chapman (2010) was adopted in conjunction with that of Ellaway *et al.* (2007) to create a specific definition but one that retained its design and andragogical freedom. This was used throughout this research.

> *''A virtual patient is an interactive computer simulation of a computer programmable patient (or avatar) in a real-life clinical scenario for the purpose of health training, education, or assessment that will respond to learner decisions.''* (The adopted study definition of a VP, adapted from Ellaway *et al.* 2007, Bracegirdle and Chapman 2010).

2.3.3 Theoretical considerations

VPs have been cited as lacking a theoretical foundation which can make it difficult for researchers to build on previous work and create a well-established and significant literature base for their use (Georg and Zary 2014). For this reason, it is important that VP's educational foundations are considered and incorporated into designs from the offset, although VP designs need to be tailored to their specific contexts and intended purposes (Ellaway *et al.* 2009). Depending on, for example, if the case is for self-directed learning or problem-based learning; or is to teach communication skills or clinical reasoning, the design will vary significantly (Ellaway *et al.* 2009). Most VPs stem from pedagogical and andragogical rationales of experiential or problem based learning with narrative VPs especially using theories of reflective learning through practice (Bearman *et al.* 2001).

A grounded-theory study explored optimal VP designs considering educational theories (Bateman *et al.* 2013). The themes identified were used as a basis for a VP framework with one element of the framework being 'VP construction'. This category, in part, consisted of

pedagogical properties (Bateman *et al.* 2013). This was one framework addressing VP designs to understand how and why the design and delivery of VPs influence learning. From the identified categories it is key that pedagogical and andragogical properties have a role to make VPs educationally worthwhile.

The use of simulation, and more specifically of VPs, allows for repetition and the opportunity to practice fine-tune skills (Crea 2011). 'Traditional' learning methods such as didactic lectures are one step in developing competence often via repetition, but by using simulation there is an opportunity to practice, build confidence and increase accuracy (Crea 2011). This stage of 'deliberate practice' is recognised to be one stage in the path to mastery in health education (Scalese *et al.* 2008). When using simulation, it is also important to provide feedback and/or assessment, this acts as a method of debriefing, a key stage in the learning process (Crea 2011). This is also in line with Kolb's experiential learning cycle (Kolb 1984) as discussed in section 1.4.2. Feedback in VP scenarios, due to current designs, can be limited but in traditional methods there are equally no guarantees that this is comprehensive or coherent but if done well can be extensive. This is an area of ongoing development and evaluation in VPs to provide useful and structured feedback without completely loosing variability between individuals.

A pertinent statement which summarises the significance of VPs and learning is that *VPs:*

> *''are not merely an object/tool but rather a learning activity''* (Georg and Zary 2014).

This embraces the idea that VPs are a learning activity and consequently need a strong educational foundation, they are not simply a method of delivery. This stance has been adopted throughout this research study in an attempt to ensure that the VP under evaluation is evaluated considering educational theory and learning.

2.3.4 Designs

There are many VP designs which are, in part, reflective of the definition range (section 2.3.2) and by the progression of the technology over time. Early designs, such as the one discussed by Stevens *et al.* (2006), were especially limited due to the abilities of the technology. VP technology can incorporate various technological modalities named examples being voice recognition, eye-tracking software, animations, videos, and written information. VPs vary in design but features include: the level of interactivity; the ability of the system to track performance; the method by which information is requested and provided; the type and delivery of feedback; the type and delivery of assessment (if incorporated within the system); integration of other multimedia and; how the technology is structured, developed and maintained (Guise, Chambers, Conradi, *et al.* 2012).

The two main types of VP design are linear and branched (narrative). Branched VPs are the focus of this dialogue, but some linear VPs are also included. Linear designs, such as the one by Pereira and Cavaco (2014) do not allow progression within a case on the basis of an incorrect decision. If an incorrect decision is selected, the programme will return the user to reattempt the question. Some systems will allow a maximum number of attempts or a time limit (Pereira and Cavaco 2014).

Branched VPs have alternative routes through the case and can potentially have several conclusions. The cases do not correct mistakes and allow the user to complete the case before giving feedback. They focus on decision making and emphasise patient-centered approaches, encouraging users to reflect on their performance and the case outcomes in line with reflective learning (Guise, Chambers, Conradi, *et al.* 2012). Although branched designs can be more expensive to produce than linear, as each pathway has to be carefully designed and there is limited opportunity to use a case template (Bearman *et al.* 2001).

The designs of a branched and a linear VP to teach communication skills to medical students were compared in one study in an attempt to establish the preferred design (Bearman *et al.* 2001). Although conducted almost 20 years ago (1998-1999), the results appear to still be pertinent as narrative VPs were shown to be favourable for teaching communication skills, something that is still referred back to and discussed today (Huwendiek *et al.* 2009, Saleh 2010, Guise, Chambers, and Valimaki 2012). In the original study, the student participants were assessed via an standadised patient interaction at baseline and after using the VP. This outcome may have been limited by outside confounders due to possible subjectivity between standardised patients (Bearman *et al.* 2001), but as an exploratory study, it was a pioneering evaluation of VP design.

Guise, Chambers, Conradi, *et al.* (2012), suggested that when designing a branched VP, the 'ideal' case pathway case should be developed first before alternative pathways based on other choices and decisions are created. This method was also adopted by Bracegirdle and Chapman (2010) and Shah *et al.* (2012). The primary pathway helps mark important stages in the case and aids the development of feedback linking to each decision (Guise, Chambers, Conradi, *et al.* 2012). Within Guise, Chambers, Conradi, *et al's.* (2012) review, five phases for the development of VPs were established. *Understanding educational needs and learning goals*, which includes the integration of the VP case into a wider curriculum with specific learning outcomes. This stage is echoed to be important in multiple other studies (Edelbring *et al.* 2011, Pereira and Cavaco 2014, Hege *et al.* 2016, Baumann-Birkbeck *et al.* 2017). The second stage concerns *Conceptualising and designing*, this concerns the transition of the learning outcomes into a task and the third and fourth stages of *design and construction of multimedia components*, or the technical aspects of development, and *usability and evaluation*, which can incorporate content validity assurances. The final stage is *improving the design*, which further refines the designs following feedback in the previous phases. Aspects of

this were adopted in the development of the VP under investigation as discussed in Section 1.5.3.

The VP discussed by Bracegirdle and Chapman (2010) was similar in design to the VP of this study as it followed a branched design using decision trees to map the case pathways. The system did not make the user aware that they had made mistakes and the VP itself provided feedback at the end of the scenario. The authors discussed how experiencing the consequences of clinical mistakes is a learning tool supplementary to the programme's overt intentions of improving communication skills. The system was stated to be adaptable to a range of settings such as individual or group use and could include both formative and summative assessments. It was used to teach undergraduate pharmacy students but, the authors highlighted the potential of the technology to teach qualified pharmacists (Bracegirdle and Chapman 2010).

2.4 Virtual patient use

The next part of this chapter summarises the use of 'VPs' in various health professions. Throughout this section, VPs are made reference to but there are a range of VP designs and definitions, this is highlighted where relevant. Many of the technologies are referred to as VPs, but they may not be completely in keeping with the adopted definition of this research, they are presented to give an overview of health 'VP' technologies.

2.4.1 Medicine

In medicine, some of the most common VP applications appear to teach communication skills, clinical reasoning, and history taking. High fidelity mannequins appear to be particularly common in medicine and nursing to teach practical skills, such as cardiopulmonary resuscitation (CPR) (Lin *et al.* 2011). A well-adopted medical VP is *Harvey,* a cardiology patient simulator. This is a high-fidelity VP, but despite this, the research evidences mainstream

integration of a simulation technology. *Harvey* was designed in the USA but has now been adopted to multiple U.K. medical schools for undergraduate teaching, suggesting a degree of generalisability. *Harvey* has also proved popular on student satisfaction surveys and was rated highly at the end of course monitoring for assessing academic standards (Issenberg *et al.* 2003).

One study provided an overview of the use of ethical VPs in medical students in multiple U.K. universities, this demonstrated an extended role of VPs outside of the initial clinical domain. The authors stated that the VPs were popular, increased enjoyment of learning, and potentially improved ethical decision making by creating relatable ethical scenarios; there was limited evidence presented to support this conclusion (Hooper 2015).

Botezatu *et al.* (2010) developed a framework for VP design and evaluated VP use in medical students, identifying that their main purpose was to develop critical reasoning skills. This is something that has been identified as the main purpose of medical VPs but appears to be less investigated in other professions. It was suggested that VP use possibly has a regulatory-effect on a personal level as VPs can help students to plan their learning (Botezatu *et al.* 2010). This looks to be absent elsewhere in the literature but appears to be an evidenced conclusion. In the study particular importance was placed upon including the user's perspective to successfully develop VPs. The main themes identified were *learning, teaching, assessment, authenticity, and implementation* (Botezatu *et al.* 2010). Qualitative methods were used, and another area discussed was that VPs aided the development of critical reasoning through a combination of ''*developing transferable skills, knowledge retention and enhancement, and highlighting the importance of making mistakes*''. The students identified that the VPs were useful across all clinical specialties, particularly to support the learning of topics not seen during clinical rotations, an already recognised advantage of VPs (Ellaway *et al.* 2009). The students thought that communication skills fell outside of the scope of VPs, but, this may be because the VP was linear with case study characteristics; no animations or avatars were

incorporated (Botezatu *et al.* 2010). The authors identified some limitations with their system and stated that to reach its educational goal, a VP must meet a level of authenticity and overcome implementation barriers (Botezatu *et al.* 2010).

Psychiatry has made use of VPs, for example, Shah *et al's* (2012) work evaluated the use of a VP in medical students to teach and assess student's abilities to identify major depression symptoms. Results had favourable opinions on VP use: it was enjoyable, simulated real life and was a good educational tool (65.4%, 24.1%, and 65.8% agree it was good/excellent on a five-point Likert scale respectively) (Shah *et al.* 2012). Likewise, a rheumatology-based phenomenology study in a sample of Swedish medical students, found that VPs promoted clinical reasoning and helped student's transition from textbook to 'actual patients' (Edelbring *et al.* 2011). Still, VPs were found to lack emotional interactivity and the complexity of real patients. This VP also lacked a level of technological sophistication as the VP cases were presented by video clips, images, and text; there were no animations or direct user interaction with a patient. The students reported that despite the absence of external pressures, they did not want to lose face in the situation and wanted to appear knowledgeable. A concluding statement was that VP use was not yet conceptually established and that additional research could add to the conception of VPs and their uses (Edelbring *et al.* 2011), highlighting requirements for further research.

Tan *et al.* (2010) discussed three examples of VPs used in geriatric medicine, including some which were peer-reviewed and well established in U.S. medical schools. The evaluation was not detailed but the VPs were suggested to be effective, well-liked and successful. Further research requirements included considerations for different users, assessment integration and curriculum development (Tan *et al.* 2010). Similarly, a small pilot study of medical students trialled the usability, accessibility, and acceptability of one VP aiming to develop clinical reasoning skills (Patel *et al.* 2011). Findings suggested that VP users required little instruction on the use of the software but that performance when using a VP could be adversely affected

by technological barriers, these must be overcome before the technology becomes a useful learning experience (Patel *et al.* 2011). This highlights the need for functional, effective technology to be available before any learning can occur.

There has been less research conducted regarding the use of VP in qualified doctors. One planned study incorporated a VP into a CPD programme on smoking cessation for doctors. It was hoped that the programme would improve smoking cessation consultations by creating an opportunity for practice and performance feedback, disappointingly results are not available (Ruiz 2011).

The literature concerning medical VPs showed varied research. There was a reasonable quantity, but studies were individualised and did not merge easily into a body of evidence. Many of the technologies were unique with wide-ranging purposes and evaluations, there is a clear gap regarding the use of VPs in qualified doctors. This is something echoed in other professions (sections 2.4.2, 2.4.3 and 2.4.4) and evidences the need for research into VP use by qualified professionals.

2.4.2 Nursing

Nursing appears to be second to medicine in the volume of VP related research. Research has shown nursing students find it difficult to apply theoretical knowledge in a clinical context and VPs have been trialled to bridge theory and practice (Georg and Zary 2014). Similar to medicine, VPs to develop clinical reasoning have been assessed in nursing. One study found that VPs were engaging and they supported the development of clinical reasoning skills, although review methods were not discussed (Georg and Zary 2014).

Another study initially developed a framework for VP design, before the authors created, evaluated, and implemented a VP in qualified mental health nurses. The study was cross-European and rigorous validity testing was undertaken. Findings focused on the design and implementation of the VP and the authors stated that the VP had good feedback but did not

elaborate; the exact aesthetic of the VP was unclear (Guise, Chambers, Conradi, *et al.* 2012). It was stated that in-depth evaluative research into narrative VPs was required and, as this study is one of only a handful that used VPs in qualified HCPs, it shows a need for more research in this area.

A further study that used qualified nurses as participants, considered the use of VPs for formative assessment to develop clinical reasoning skills (Forsberg *et al.* 2016). Using deductive content analysis of participant self-evaluations, the authors reported that there was a progression of clinical reasoning throughout the course. The course involved three VP assessments hosted on *Web-based Simulation of Patients,* a well-evaluated VP system (Zary *et al.* 2006, Forsberg *et al.* 2016). Evaluation tools were based on Kolb's Learning Cycle (Kolb 1984), a key part of which is reflection to gain experience in a deeper way. Over time, the participants moved through the cycle and became more aware of the clinical reasoning process. Generalisability to other scenarios was limited, as stated by the authors, due to the sample size (n=14) (Forsberg *et al.* 2016).

One study targeted a specific area of clinical practice that requires additional levels of nurse-led patient counselling as the basis of a VP (Moule *et al.* 2015). The branched VP trained nurses in prostate cancer counselling, and it was developed to be part of CPD; participants included qualified nurses and students. A mixed methods evaluation was employed, and most users recommended the VP to others, some indicated that it would positively impact their practice. A negative aspect of the VP was that the VP was an isolated learning opportunity, as there was little opportunity for peer-based learning. The authors responded by stating that a blended learning programme may be most appropriate to integrate this VP into practice. Within the scenario, a novel design feature was that the nurses were interrupted and had to decide if to carry on the consultation or if to deal with the distraction, this added to case authenticity (Moule *et al.* 2015).

In nursing, VPs appeared to be well-liked and usable but there is still a need for wider investigation and integration, especially using qualified staff.

2.4.3 Multi-disciplinary applications

The use of VPs has been applied to a range of multi-disciplinary settings and some studies have used several types of HCP as participants. VPs were used to complement a CPD course normally involving standardised patients, and findings showed that VPs were equivalent to standardised patients for improving performance and diagnostic ability (participants in the intervention group experienced a greater increase in their ability to diagnose when compared with the control group, P=0.054). This was not significant but the authors stated there is a potential place in training for qualified healthcare professionals (HCPs) using this technology (Triola *et al.* 2006). The HCPs involved were mostly nurses and doctors with a proportion of 'other providers', with no elaboration (Triola *et al.* 2006).

A Cochrane review was planned to evaluate the use of VPs for HCP education. It aimed to evaluate VP effectiveness versus traditional learning, other types of simulation and other types of e-learning, the review disappointingly has now been withdrawn with no reason provided (Kononowicz *et al.* 2016). The review had hoped to consider the education of both pre-registration and post-registration HCPs and a range of HCPs, including pharmacists. The review protocol acknowledged that those already trained have equally important continuing educational needs as those unqualified or in training and that VPs may help to meet these needs. The review was only to include randomised controlled trials (RCTs) and cluster RCTs which may have limited eligibility (Kononowicz *et al.* 2016).

A meta-analysis considered the use of VPs across health education against either no intervention or another form of education (Cook *et al.* 2010). The analysis involved six databases and included all types of HCP. A mixture of qualitative; quantitative-intervention controlled and non-controlled; and comparative studies were identified and analysed. It was

cited that comparisons between this range of method were difficult and only limited conclusions could be drawn. Qualitative studies were excluded from the meta-analysis. When compared to no intervention VPs were consistency associated with higher learning outcomes (pooled effect sizes >0.80 for outcomes of knowledge, clinical reasoning, and other skills); there were small and insignificant findings when VPs were compared with other non-computer based interventions (pooled effect sizes -0.17 to 0.10 and non-significant). The review concluded that VPs were non-inferior to other methods but an advantage was that they may remove logistical barriers for providing education (Cook *et al.* 2010).

A similar review found that, although the nature and use of VPs vary widely, VPs are well suited to the development of history taking, examination, communication skills, and procedural skills to name a few examples (Cook and Triola 2009). But, in order to become competent in these skills there are three components to master: *understanding the principals involved; using the skill efficiently and; performing the skill effectively*. The latter two principles are particularly where VPs are useful especially as they may help transfer knowledge into practice (Cook and Triola 2009).

A review of studies incorporating multiple professions stated that virtual simulation, including VPs, holds promise for CPD but that this requires in-depth research as well as considerations for placement within a particular curriculum (Duff *et al.* 2016). The authors also stated that regardless of profession, virtual simulation programmes are more effective in the earlier stages of training (Duff *et al.* 2016), but only three studies supported this finding and only one included qualified professionals: six medical doctors. These studies had small sample sizes and limited significance. The review stated that virtual simulation has been shown to be as effective, and in some cases superior to traditional educational approaches and their use for qualified professional's CPD should be investigated (Duff *et al.* 2016).

The evidence for the use of VPs in a range of health professions shows the efficacy of some VP technologies, but the body of literature is still lacking and multiple studies have signalled the need for more research, especially in qualified HCPs. Ultimately, there were vast differences between the studies, their technology, and designs.

2.4.4 Pharmacy

VPs in pharmacy have been investigated using a range of VPs designs, methods, and participants. This will be explored in more depth in chapter 3, a brief overview is presented below.

A review by Jabbur-Lopes *et al.* (2012), highlighted that there were few relevant studies on VPs in pharmacy, only seven at the time. Most of these involved participants, mostly students, interacting with a VP followed by an evaluation. Evaluation methods all included an element of user satisfaction, typically via a questionnaire. Five of the seven studies also assessed some form of competency such as clinical ability; all the studies used quantitative methods. VPs were used as a method of practising either clinical or communication skills or both; some involved an assessment; others were purely learning resources. But, in all seven cases, the authors reported a high level of user satisfaction. Some of the studies did not discuss their limitations and most were not able to generalise beyond their original samples. The review stated the need for more studies into VP use, using broader populations. This is true for graduate and undergraduate applications and the use of VPs needs to be tested internationally to authenticate uses (Jabbur-Lopes *et al.* 2012). The authors discussed the lack of validated instruments to evaluate VPs and this was something also found in this study during the questionnaire design process (section 5.4.1). Furthermore, most studies in the review were conducted in the U.S, which highlights that the U.K. and Europe are lagging behind in being VP pioneers; all of the studies were conducted on students. The need for more

sophisticated graphics and animations are required according to the review recommendations (Jabbur-Lopes *et al.* 2012).

VPs in pharmacy have been used for a range of applications. One review considered the use of simulation to teach pharmacy-practice to pharmacy students and investigated how this translates to patient care (Kane-Gill and Smithburger 2011). Results found that the most common applications were in therapeutics, communication, physical examination, patient safety and care for populations not exposed to in practice. This review included all types of simulation; only two out of 17 studies used VPs, most were high fidelity mannequins. Other technologies included standardised patients, simulation goggles, and a 'dispensing and counselling' simulation. The lack of VP-specific research adds to the growing evidence for further VP investigation. The review stated that simulation has established value in teaching pharmacy students but this has not been transmitted to CPD for qualified pharmacists (Kane-Gill and Smithburger 2011); a key area that this research will address.

Multiple studies have been conducted into the use of VPs for undergraduate pharmacy students (Battaglia *et al.* 2012, Cavaco and Madeira 2012, Al-Dahir *et al.* 2014, Bindoff *et al.* 2014, Pereira and Cavaco 2014, Smith *et al.* 2014, Menendez *et al.* 2015, Smith and Benedict 2015). Many of these used designs incorporating a mixture of pre and post-tests, and satisfaction surveys, often using Likert scales (Douglass *et al.* 2013, Al-Dahir *et al.* 2014, Bindoff *et al.* 2014, Smith *et al.* 2014, Zlotos *et al.* 2016). Most of the studies investigated the possible change in knowledge immediately after using the VP; only one study considered long-term outcomes (Bindoff *et al.* 2014), this is a drawback when evaluating VP literature.

Several studies had similar results: comparing the use of VPs and paper-based learning, VPs were found to be superior and improve knowledge and counselling skills and were more fun and engaging (Battaglia *et al.* 2012, Douglass *et al.* 2013, Bindoff *et al.* 2014, Smith *et al.* 2014, Zlotos *et al.* 2016). A study simply evaluating VPs without a control also had positive results,

suggesting the need for increased VP technology (Smith and Benedict 2015). Positive user feedback, satisfaction, and change in confidence have also been reported.

It appears that the vast majority of the studies evaluating VP use in pharmacy were conducted on students rather than qualified professionals and there is a need for further research in this area. Battaglia *et al.*, (2011) trialled their VP on almost 50 pharmacists in addition to pharmacy students and measured changes in knowledge and confidence. It was reported that participant's confidence significantly increased after VP use (pharmacist change -0.4, P=0.03; student change -0.7, P=0.01, where a negative score is an improvement in confidence). Overall, there were greater benefits reported in the pharmacist group compared to students, this suggests the potential significance of educational interventions aimed at pharmacists (Battaglia *et al.* 2012). No studies focused on VP educational interventions in qualified pharmacists, this further enforces the need for this piece of research.

VPs in pharmacy appear to have shown themselves to be effective tools for undergraduates but, what is still absent from the literature is evidence for the use of VPs in qualified pharmacists, which is the main topic of this study.

2.5 Research needs

Due to increasing economic pressures, raised expectations and reduced resources, the training of HCPs is increasingly under pressure and it has been suggested that VPs may offer a step to resolving some of these issues (Cook and Triola 2009), especially as they are unique in their almost unlimited design potential (Stevens *et al.* 2006). VP software has demonstrated distinct advantages in healthcare, particularly for those in the process of becoming qualified HCPs. Advantages include versatility, mobility, and accessibility to maximise scenario realism with a low level of risk (Douglass *et al.* 2013). This is relevant as it has already been discussed that one area needing further research is authenticity and learner engagement of VPs (Hege *et al.* 2016).

Many studies do not clearly discuss VP design (Guise, Chambers, Conradi, *et al.* 2012) and few studies use sophisticated technology with some using now out-dated video-based technology as opposed to animation (Stevens *et al.* 2006, Shah *et al.* 2012). This suggests a gap in the literature involving more recently developed VP technology (Edelbring *et al.* 2011). As already discussed, some studies had limited sample sizes and limited generalisability both from the point of view of the study designs and of the technologies to be used outside their original applications. Jabbur-Lopes *et al.* (2012) highlighted the relevance of limited generalisability and the need for research in wider populations to validate VP use. Most studies cited originated in the U.S and few were conducted in the U.K. or Europe; there is a gap in the literature considering the use of VPs in additional localities. There is also a large amount of research in medicine but this appears to be less true of other professions and similarly, VPs account only for a small proportion of research into the wider concept of simulation (Vyas *et al.* 2013, Kononowicz *et al.* 2015). This suggests that VPs may not be as conceptually established as other types of simulation which is in keeping with findings by Edelbring *et al.* (2011). A number of the discussed research needs have been incorporated into this study with the intention to investigate a clearly and recently designed VP.

VPs have been suggested to be non-inferior to traditional teaching methods and they can potentially remove some logistical barriers associated with providing educational interventions (Cook *et al.* 2010). But, despite evidence for VP use, no study has primarily focused on qualified pharmacists as VP users. This is especially relevant as those already trained as HCPs have equally important continuing educational requirements as students and VPs may potentially be one way to meet these needs (Kononowicz *et al.* 2016). The possibility to teach qualified HCPs including pharmacists has been highlighted as a future research area by multiple studies (Bracegirdle and Chapman 2010, Kane-Gill and Smithburger 2011, Duff *et al.* 2016, Thompson *et al.* 2016a, 2017), further demonstrating the need for this evaluation which includes qualified pharmacists as participants.

2.6 Summary

This chapter presented an overview of the use of VPs in healthcare. This included VP designs, definitions, educational foundations, and purposes, as well as evaluations of VPs in the literature. The wider spectrum of simulation was highlighted along with the position and role of VPs within this. The advantages and disadvantages of VPs were debated as well as considerations for the potential implications of VP use. VP roles in practice were also considered, including how they compare to alternative modalities and how VP use may overcome barriers associated with other resources. Some current applications of VPs in a range of disciplines were conversed. An overview of pharmacy-specific research was presented to understand the systematic review that follows. Research needs and recommendations have been emphasised throughout. This dialogue has provided insight into VP research and has indicated where this study will provide well-needed evidence regarding the use and integration of VPs into clinical pharmacy practice.

3 Systematic narrative review

3.1 Introduction

This chapter follows on from an overview of the literature on the use of VPs across a range of health settings, including a discussion of their designs and purposes. In this chapter, this will be further explored through a systematic narrative review of VP use specifically in pharmacy education. The review methods will be presented, which includes the search terms and databases used, as well as the eligibility criteria, and how the quality of the literature was assessed. There is an explanation of the searches undertaken and the resulting literature retrieved. The studies are critiqued relevant to the wider VP evaluation to identify gaps and inconsistencies in the literature. This review has been published in The BMJ Simulation and Technology Enhanced Learning (Richardson *et al.* 2019).

3.2 Objective

The focus of this review was VPs as a sub-type of simulation. The objective was to establish and evaluate the literature on the use of VPs in pharmacy, where 'VPs' are clearly defined. This included VPs that were used to develop or contribute to, communication or counselling skills, in pharmacy undergraduate students, pre-registration pharmacists, and registered pharmacists. Communication and counselling skills were chosen as there had not been a previous review which investigated this specifically, despite this being recognised as a purpose of VPs (Kane-Gill and Smithburger 2011). Secondary outcomes were to gather information on the evaluation methods of the studies.

3.3 Methods

Chapter 2 presented an overview of VP literature and it was clear from this that VP uses in various professions were varied as were the designs, definitions, and evaluation methods. On the basis of

this, the use of VPs within pharmacy needed to be established with a focus placed upon technology identifiable with that of the wider study, either in design or purpose.

A systematic narrative review attempts to collate literature using pre-defined criteria to meet a specific objective (Liberati *et al.* 2009). This includes a clearly defined search strategy with considerations for study validity and quality with the systematic presentation of the characteristics and findings into one narrative (Thomas and Harden 2008, Liberati *et al.* 2009). A systematic narrative review is useful to collate literature that is unsuitable for meta-analysis (Popay *et al.* 2006, Cochrane Collaboration 2018). This method was chosen because the VP studies used varied VP designs, evaluation designs, methods, and outcomes. This meant that meta-analysis was not plausible, a cited problem in another VP review (Cook and Triola 2009).

The PICOS (population, intervention, comparison, outcomes, and study design) approach for determining eligibility criteria and elements of the PRISMA guidelines (Liberati *et al.* 2009, Moher *et al.* 2009) were used in the reporting of this review.

3.3.1 Eligibility criteria

The inclusion and exclusion criteria used PICOS to identify studies that were suitable for the review (Table ***3.1***) (Moher *et al.* 2009), although, there were some limitations to this method as some VP evaluations did not use a control as the focus was on the technology. Therefore, the PICOS framework was not ideal and was used only broadly to provide structure for the eligibility criteria. Ultimately, the eligibility criteria did not discriminate between study designs or outcomes but rather focused on the VP designs and purposes (Table ***3.1***). This maximised eligibility on the basis of the VP technology although studies had to include VPs that incorporated communication or counselling skills. The review did not exclude studies on the basis of their design or outcomes. If the nature of the VP technology was unclear and could not be established the study was excluded as this was the highest priority assessment in deciding eligibility. Grey literature was also excluded as this is recognised to have not been formally published and in some cases peer-reviewed (Jesson *et al.*

2011). It was also unlikely to be returned by the search engine used. All types of participants were included provided some aspect involved pharmacy students, pre-registration trainees or qualified pharmacists.

PICOS	Inclusion	Exclusion
Participants	Studies that used pharmacists, pre-registration pharmacists, and pharmacy students.	Studies not using qualified pharmacists, pre-registration pharmacists or student pharmacists. Where studies used more than one type of participant, provided part of this met the inclusion participant criteria the study was included.
Intervention	Studies evaluating, using or developing a VP that is in keeping with the definitions of this study or one that teaches, develops or contributes to counselling, communication or consultation skills. This had to include direct patient interaction.	Studies incorporating a VP that is not in keeping with the definition of this study or with the purpose of the VP in this study. This included high-fidelity programmes and case studies. Where studies involved multiple technologies provided at least one was a VP the study was included. If the nature of the VP could not be established the study was excluded.
Comparisons	Studies using, evaluating or developing a VP with or without a control.	Studies were not excluded on the basis of the presence or absence of a control.
Outcomes	All VP-related outcomes were considered including knowledge and confidence, perspectives, thoughts, and implications.	Studies were not excluded on the basis of the presence or absence of particular outcomes provided the VP and population were relevant.
Study Design	All designs were included provided the nature of the VP was appropriate.	Studies were not excluded on the basis of their design. Conference abstracts, pilot studies, descriptive studies and 'grey-literature' were excluded.

Table 3.1 Eligibility criteria for inclusion of a research study in the systematic review

3.3.2 Databases

The EBSCO search engine was used to undertake the literature search. This enabled a selection of health, pharmacy, and educational databases to be screened; Medline, AMED, CINAHL, and ERIC as summarised below (Health Education England and NICE 2018). Searches used a comprehensive series of search terms selected from Medical Subject Headings terms and combined using Boolean operators. Similar to Peddle *et al.* (2016), only studies from post-2000 were included as initial searches revealed that the majority of VP literature was from this timeframe. Electronic databases searches were accompanied by manual searches of the reference lists of eligible studies.

- CINAHL - Cumulative Index to Nursing and Allied Health Literature. This includes allied professionals and is also cited to include health education studies. It was anticipated that multi-disciplinary studies may be retrieved.
- Embase - Excerpta Medica Database. Consists of three smaller databases and includes specific pharmacy or pharmaceutical studies covering many aspects of health.
- Medline. A general medical database, interests include continuing education.
- ERIC - Education Resources Information Center. A database of educational literature and resources.

3.3.3 Search terms and strategy

A combination of 'virtual patient', avatar, 'computer simulation', education, counselling, communication, pharmacist, pharmacy, 'pharmacy student', 'Pharmacy Undergraduate', 'Pre-reg', and 'Pre-registration' were used. Synonyms of the terms were incorporated to make the strategy as comprehensive as possible. It appeared that relevant technology was most commonly referred to as a virtual patient but for completeness 'avatar' and 'computer simulation' were also included. Other terms trialled were 'pharmaceutical' and 'serious gaming', but these were found to be too broad and too restrictive respectively. Different variations of words were considered, for example, programme versus program. The search was re-run frequently to update the findings, the last being in May 2019.

((('Virtual patient' OR avatar OR 'computer simulation' OR 'programmable patient' OR 'programable Patient' OR 'computerised patient' OR 'computerized patient') AND (pharmacist OR pharmacy OR 'pharmacy student' OR 'pharmacy undergraduate' OR 'pre reg' OR 'pre registration') AND (education OR training OR counseling OR counselling OR consultation OR communication))). [The adopted search strategy for the systematic review]

3.3.4 Study selection

Study selection was based on the work by Moher *et al.* (2009) to search for and screen potential studies using the approach of *identification, screening, eligibility, and inclusion* (Figure 3.1) (Moher *et al.* 2009). *Mendeley* reference management software was used throughout. The search was undertaken, and duplicates removed before the titles were screened. Only studies that were obviously unrelated to the review topic were excluded, this accounted for the majority of exclusions. Study abstracts were then screened with those that did not meet the criteria being excluded. The remaining studies underwent an in-depth screen with an emphasis on the methodological quality and findings (Table ***3.2***). Where a foreign language study was found, a search for an English version was conducted or *Google Translate* was used to translate the title; no foreign language studies were involved past title screening. Similarly, if the nature of the VP was unclear, for example, *VPsim* technology (https://let.pitt.edu/vpsim/) was repeatedly cited but this was not always accompanied by a description, a *Google* search established the nature of the technology. If the technology was still unclear the study was excluded. The findings of the studies were thematically analysed and this is reported in section 3.4.3. A thematic approach was used due to difficulties in making direct comparisons between studies as suggested by Thomas and Harden (2008).

3.3.5 Assessment of quality

The main quality assessment instrument that was used was an appraisal tool which was designed to evaluate educational interventions (Morrison *et al.* 1999). The instrument asks nine key questions of a study including: is the nature of the intervention clear and, are the outcomes chosen to evaluate

the intervention appropriate? This tool was the main instrument used to evaluate the quality of the studies included in this review, although the critical skills appraisal skills programme (CASP) tools for qualitative research, cohort studies and randomised controlled trials (Critical Appraisal Skills Programme 2018a, 2018b, 2018c) were also used to supplement the tool by Morrison et al. The quality of the studies is summarised in Table ***3.3***.

In addition to the nine questions covered by Morrison *et al.'s* appraisal tool, other factors which were considered in the quality assessment concerned the quality of the study design and reporting. Named factors included the study setting and participants; recruitment and sampling; ethical approval; study instruments; quality measures and limitations; and the outcomes measured. These were decided upon after reviewing the content of the tools.

3.4 Results

Liberati *et al.* and Moher *et al.* (2009) discussed that a review flowchart should include information concerning study identification, initial screening, and eligibility assessment, this was adopted and is presented in Figure 3.1 (Liberati *et al.* 2009, Moher *et al.* 2009). The 490 studies initially identified reduced to 57 after exclusions and after full reviews, 8 studies remained. Most exclusions occurred in the first phase, the most common reason being that the studies did not relate to VPs or pharmacy; a noticeable volume of studies related to medicine and nursing. The most common reason for exclusions after an abstract review was that the technology did not meet the definition of the VP adopted in the wider research. A large proportion of the excluded studies, despite describing a 'VP', did not include direct patient contact such as questioning or counselling. Five reviews on VPs or simulation technologies more broadly were excluded because they were not identifiable with the aim of using VPs as previously discussed and in pharmacy populations. Each review was screened for relevant individual studies.

Review Flowchart

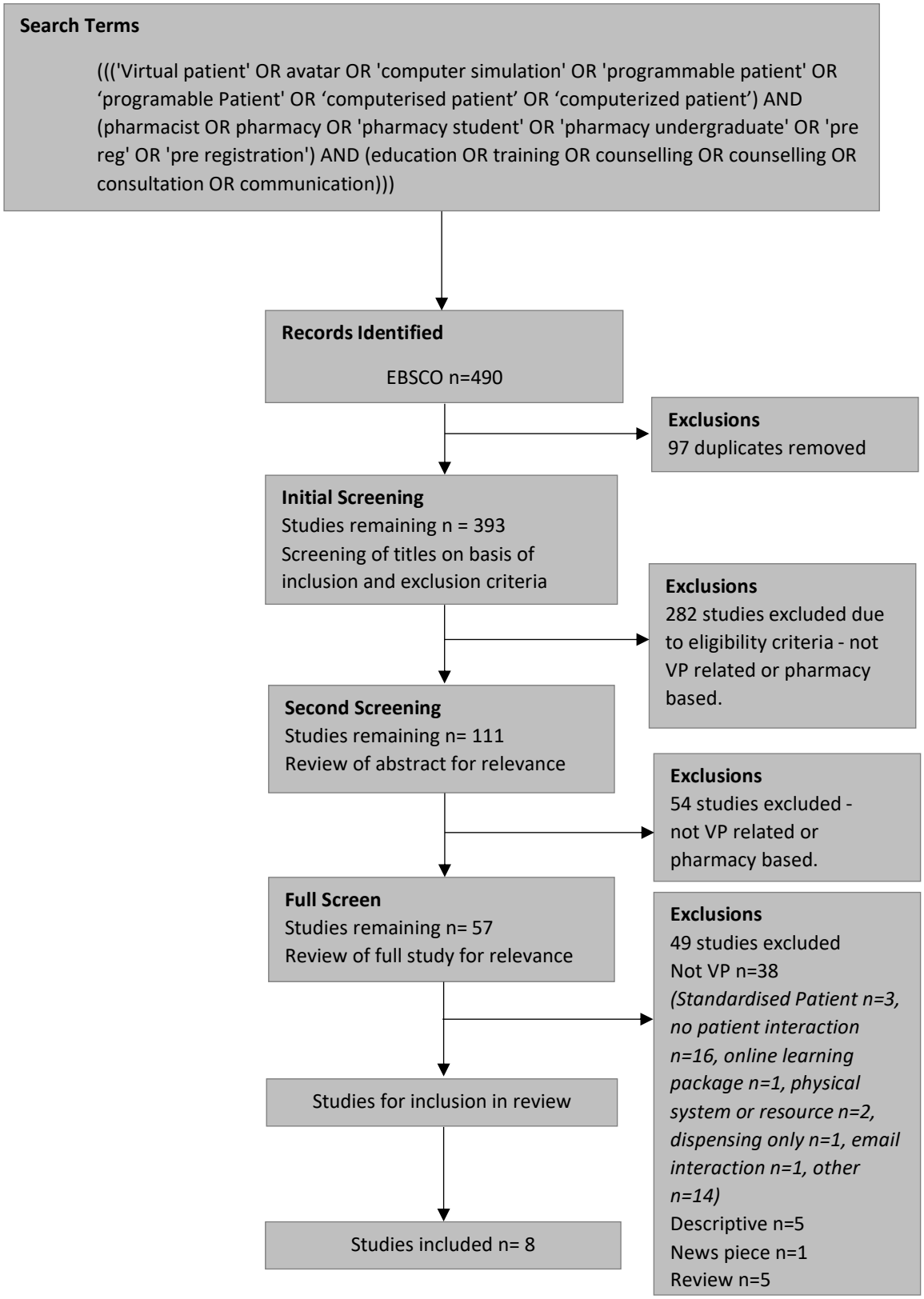

Figure 3.1 Systematic literature review flowchart

3.4.1 Study characteristics

The studies were screened to establish the nature of, and characteristics of each (Table ***3.2***). Particular importance was placed upon the VP technology and purpose. The studies all used different technologies and applications, further highlighting the difficulty in comparing them. VP purposes included improving subject-specific knowledge (Fleming *et al.* 2009, Douglass *et al.* 2013, Zlotos *et al.* 2016), clinical care (Zary *et al.* 2006, Shoemaker *et al.* 2015), and communication skills (Taglieri *et al.* 2017). In relation to participants, four studies used pharmacy students (Loke *et al.* 2011, Douglass *et al.* 2013, Bindoff *et al.* 2014, Taglieri *et al.* 2017), one study used pre-registration pharmacists (Zlotos *et al.* 2016), and three used various healthcare professional (HCP) students (Zary *et al.* 2006, Fleming *et al.* 2009, Shoemaker *et al.* 2015). The latter was included as it incorporated pharmacy perspectives and results were available for specific types of HCP. The studies used different evaluation methods, with the commonest being questionnaires before and after using the VP; some studies used randomisation (Fleming *et al.* 2009, Bindoff *et al.* 2014, Shoemaker *et al.* 2015, Taglieri *et al.* 2017).

All of the review studies evaluated VPs within formal educational programmes, the majority being undergraduate courses. Each VP was specific to its own application and evaluation thus direct comparisons of the educational values or of the evaluation outcomes are limited. The studies were selected based on their technology, but studies could have been excluded due to an unclear description. To minimise this, whole papers were closely scrutinised where clarity was lacking.

3.4.2 Quality of studies

Half of the studies (n=4) did not report whether they had received ethical approval (Zary *et al.* 2006, Loke *et al.* 2011, Douglass *et al.* 2013, Taglieri *et al.* 2017) and none of the studies discussed considerations for sample sizes, although one did acknowledge that their sample was too small to statistically assess changes (Fleming *et al.* 2009). Where statistical analysis was used, the studies reported *P* values and significance.

Shoemaker *et al* (2015), and Fleming *et al* (2009), each randomised two groups and were medium and high quality studies respectively. The randomisation process was not detailed in either study, but both took measures to standardise outcomes and to address the quality and reliability of their findings. In both studies, the particular VP's educational contexts were not discussed. In contrast, two other studies used randomised controlled designs (Bindoff *et al.* 2014, Taglieri *et al.* 2017). Bindoff *et al*. detailed their instrument design but used a small sample (n=33) which limits the findings, especially as some results were not statistically significant (Bindoff *et al.* 2014). In the other randomised study by Taglieri *et al.*, some VP cases were compulsory and some were not, possibly skewing the sample. Additionally, the demographics of the two groups are not known (Taglieri *et al.* 2017). There was some discussion of the VP's educational context, but this was not comprehensive. Participation also declined throughout the study, and whilst it was not clear by how much, this could have affected results (Taglieri *et al.* 2017).

Two studies used before and after tests as a comparison without a control group (Douglass *et al.* 2013, Zlotos *et al.* 2016). Douglass *et al.*, presented the VP's educational context clearly, but there was limited discussion of potential bias within the study or of how the questionnaire was developed (Douglass *et al.* 2013). The study was of medium quality. Similarly, Zlotos *et al.,* provided a limited discussion of the VP's underpinning educational theory and its place within a curriculum. The evaluation was high quality but the study lost 43.4% of participants in the six months follow up, although this is not uncommon in longitudinal studies (Zlotos *et al.* 2016).

Finally, the qualitative exploratory study by Loke *et al.* was of low quality. Sampling was not reported and there was limited information on the methods, but the study did report reliability, validity, and trustworthiness. Despite limited information on the study methods, the educational principles of the VP were detailed (Loke *et al.* 2011). In the work by Zary *et al.*, which was also low quality, the VP evaluation was part of a wider study (Zary *et al.* 2006). The evaluation methods did not confer much depth and there were limitations due to the small-scale evaluation, although the description of the VP design was detailed (Zary *et al.* 2006).

Authors, Year of Publication and Study Title	Study Setting	Participants	VP Design or Description	Outcomes and Study Purpose	Methods	Findings	Limitations
Bindoff I., Bereznicki L., Westbury J., *et al.* 2014 A Computer Simulation of Community Pharmacy Practice for Educational Use	School of Pharmacy, University of Tasmania, Tasmania, Australia	Pharmacy Students	A computer simulated community pharmacy, using Unity3D game development. Users select patient dialog resulting in text responses and animations	To investigate a computer-based method for pharmacy practice compared to paper-based scenarios	Pre- and post-knowledge quiz and survey. Paper-based control	The VP group had improvements in knowledge (P=0.059; computer-based group mean change 0.6; SD 0.3 vs paper-based group mean change of -0.2; SD 0.3). Improved history taking (P=0.029) and counselling (P=0.008) and the simulation being more fun (P=0.006) also reported; no further data. The VP was as effective as paper-based alternatives	Limited sample size due to limited access to students
Douglass M.A., Casale J.P., Skirvi, *et al.* 2013 A Virtual Patient Software Program to Improve Pharmacy Student Learning in a Comprehensive Disease Management Course	Northeastern University School of Pharmacy, Boston, Massachusetts	Pharmacy Students	*TheraSim*, a web-based simulation software for HCPs. Simulations for clinical training. Identify and resolve drug-therapy problems including patient education	To consider the impact of a VP pilot on pharmacy student's clinical competence skills	Pre- and post-VP design	There were significant improvements (P<0.001) in 75% of the competencies post-VP use. Mean score difference and CI are reported for each invidiual competency. The VP allowed for student assessment	Not discussed
Fleming M., Olsen D.E., Stathes H., *et al.* 2009 Virtual Reality Skills Training for Health Care Professionals in Alcohol Screening and Brief Intervention	School of Medicine and Public Health, University of Wisconsin Madison	A mixture of HCPs and HCP students including Pharmacy Students	A self-contained, 'off-the-shelf' virtual reality simulation. Based on *SIMmersion*. Questions to ask the VP, to conduct counseling or refer. Additional videoed responses	To improve clinical skills in alcohol screening, brief alcohol intervention, and referral. Changes in clinical skills	RCT. 'Experimental virtual reality simulation program' Vs no education (control)	Demonstrated an increase in the alcohol screening and brief intervention skills of HCPs. Significant increases in the scores of the VP group at 6 months compared to the control for screening (mean change 14.44; SD 16.17; p=0.003) and brief intervention (mean change 5.82; SD 20.13; p<.04)	Volunteer sample may be more motivated. Used standardised patients but attempted to minimise limitations from this. Not clear how many

							pharmacy students
Loke S.K., Tordoff J., Winikoff M., *et al.* 2011 SimPharm: How pharmacy students made meaning of a clinical case differently in paper- and simulation-based workshops	University of Otago	Pharmacy students	SimPharm, a web-based simulation platform with a time-sensitive, persistent world where students are pharmacists. Users ask patients questions to live through the consequences of their actions	To investigate how students made meaning of their clinical case. Descriptively analyse the group's activities	Case study, paper-based and simulation workshops. Including some qualitative methods in workshops	Findings identified differences in four areas: framing of the problem; problem-solving steps and tools used; sources and meaning of feedback; and conceptualisation of the patient. These can be used in future evaluations of educational simulations	Limitations not discussed. Qualitative methods used with considerations for reflexivity and qualitative quality
Shoemaker M.J., De Voest M., Booth A., *et al.* 2015 A virtual patient educational activity to improve interprofessional competencies: A randomized trial	College of Pharmacy, Ferris State University	Pharmacy, physician assistant, and physical therapy graduate students	A case representing a patient with diabetes via the VirtualPT and DxR Clinician internet-based virtual patient software. Team to complete history and examination and then develop a management plan Learning outcome regarding team communication	Quantitatively determine whether a VP improved interprofessional competencies in various graduate students	RCT. VP IPE vs control	The VP group had significantly ($P<0.05$) greater odds of improving 4 out of 5 IPEC competencies and 3 out of 9 RIPLS items (see study for individual odds ratios). The IPE activity resulted in greater awareness of other professions scopes of practice, what other professions have to offer patients and how different professions can collaborate	The effect of the IPE case without interprofessional collaboration is not known. Participants' prior training on teamwork was not standardised nor was the instruction provided preceding the VP
Taglieri C.A., Crosby S.J., Zimmerman K., et *al.* 2017 Evaluation of the Use of a Virtual Patient on Student Competence and Confidence in	Massachusetts College of Pharmacy and Health Sciences	Pharmacy Students	The Shadow Health VP program. Aim to improve student communication performance and confidence in mock clinic visits	Assessment of VPs in a pharmacy skills lab. Effects on competence and confidence to conduct real clinic visits	Intervention group accessed the VP before a clinic visit, control used it after. Pre- and post-	Higher performance reported in the VP group (asked over 4 questions, all $P<0.001$) there was no change in confidence (56.6 to 55.3, $P=0.206$). Increased scores for the ease of use (26.6 to 76.2, $P<0.001$) and case realism (40.2 to 60.7,	The study only considered one course in one pharmacy school so had limited generalisability. Participation

Performing Simulated Clinic Visits					experience survey	P<0.001); helpfulness decreased 84.8 to 73.8, P<0.008). No SDs reported.	declined and there were changing completion thresholds. Some aspects were compulsory, but some were for extra credits
Zary N., Johnson G., Boberg J., *et al.* 2006 Development, implementation and pilot evaluation of a Web-based Virtual Patient Case Simulation environment – Web-SP	Karolinska Institute, Sweden	Medical, dentistry and pharmacy students	Web-SP: simulated patient encounter, students gather and analyse data to diagnose and treat a VP, including asking questions to gather information.	Evaluate if it is possible to develop a web-based VP simulation where teachers author the cases	Post-questionnaire (Likert) with some evaluation of system use and observation	Pilot evaluations using 1-6 Likert in HCP courses showed that students regarded Web-SP as easy to use (median 5, !RQ 4-5), engaging (median 4, IQR 3-5) and of educational value (median 4, 3-5). The system fulfilled the aim of providing a common generic platform for creation, management, and evaluation of web-based VPs	Limitations not discussed. Evaluation phase not detailed in depth
Zlotos L., Power, A., Hill D., *et al.* 2016 A Scenario-Based Virtual Patient Program to Support Substance Misuse Education	NHS Education for Scotland. U.K.	Pre-registration pharmacists (preregs)	Computer animations using computer graphics technology with dubbed voice actors. Educate on injecting equipment and opiate substitution therapy	Develop and pilot VP cases on injecting equipment and opiate substitution therapy	Pre/post tests and a 6-month assessment of knowledge and perceived confidence. No control	Perceived knowledge increase pre (median 14, IQR 12-16) to post (median 19, IQR 17-20) and at 6 months (median 16, IQR 14-17). Also, confidence increased (varied questions). There was a loss of knowledge over time, but confidence was sustained	Not all participants completed the follow-up. Use of preregs may limit the generalisability. No assessment of competence

Table 3.2 The characteristics of the research studies included in the systematic review. ***IQR – interquartile range.***

Authors, Year of Publication and Study Title	Recruitment Strategy	Sampling and sample size appropriate?	Ethical approval	Instrument development	Quality measures and significance of findings	Overall quality
Bindoff I., Bereznicki L., Westbury J., *et al.* 2014 A Computer Simulation of Community Pharmacy Practice for Educational Use	Volunteer students that met criteria regarding their level of study and year group	33 participants (16 intervention, 17 control)	The Social Sciences Human Research Ethics Committee at the University of Tasmania	A detailed description of assessments used	The VP scenarios were piloted. Discussion of statistical tests: P values and standard deviations presented. Results discussed significance	Medium
Douglass M.A., Casale J.P., Skirvi, *et al.* 2013 A Virtual Patient Software Program to Improve Pharmacy Student Learning in a Comprehensive Disease Management Course	Participation occurred automatically as part of a pharmacy course	135 participants took part in various aspects of the study	Not discussed	Limited information on knowledge questions and survey. Pre- and post-tests were non-identical	Pre-defined VP definition in the questionnaire to attempt to ensure consistency. Explanation of statistics and P values presented but limited discussion relative to results	Medium
Fleming M., Olsen D.E., Stathes H., *et al.* 2009 Virtual Reality Skills Training for Health Care Professionals in Alcohol Screening and Brief Intervention	Recruitment via email and screened via phone. Monetary payment for participation	102 participants over two groups (n=51 in each). No calculation, states sample too small to assess some statistical changes	The UW Madison Health Sciences Human Subjects Committee	Detailed description of the VP, the training of standardised patients, marking and QA	Univariate analysis assessed effect of demographics. Mean scores before and after intervention with t-tests and P values	High
Loke S.K., Tordoff J., Winikoff M., *et al.* 2011 SimPharm: How pharmacy students made meaning of a clinical case differently in paper- and simulation-based workshops	Not discussed	20 participants. Fourth year BPharm students	Not discussed	Discussion of VP. Study used recordings and observation so no instrument	Considerations for transferability, objectivity, reliability, and triangulation. Analysis not detailed due to qualitative approach	Low
Shoemaker M.J., De Voest M., Booth A., *et al.* 2015 A virtual patient educational activity to improve	Not discussed	72 fifth semester pharmacy (n=33), fourth-semester physician assistant (n=27) and fourth-semester physical therapy (n=12)	The Human Research Review Committees at Grand Valley State University and Ferris State University	Description of instrument: mixture of self-designed and recognised but no further exploration	Chi-squared tests, odds ratio, and P values reported. Used the recognised measures within self-designed instruments	Medium

interprofessional competencies: A randomized trial		graduate students. No size calculations				
Taglieri C.A., Crosby S.J., Zimmerman K., et *al.* 2017 Evaluation of the Use of a Virtual Patient on Student Competence and Confidence in Performing Simulated Clinic Visits	Participation occurred automatically as part of a pharmacy course	Control n=140 Intervention n=5 141. No further comments on sampling	Not discussed	Order of labs, clinics, and VP use presented. Explanation of assessment and the survey	Peer review of study instruments and protocol. Statistical significance considered, results discussed relative to significance and P values presented	Medium
Zary N., Johnson G., Boberg J., *et al.* 2006 Development, implementation and pilot evaluation of a Web-based Virtual Patient Case Simulation environment – Web-SP	Students from the Karolinska institute	Pharmacy students n=90. Focus on development of software rather than evaluation	Not discussed	Focus on VP design, evaluation tools not discussed	No considerations for measuring significance and no explanation of evaluation	Low
Zlotos L., Power, A., Hill D., *et al.* 2016 A Scenario-Based Virtual Patient Program to Support Substance Misuse Education	Participation was part of a mandatory educational program	Interviews of 20 trainees (11 control, 9 VP), with 4 trainees having used both case studies	The NES research governance group considered the study. Guidance was sought from the Chief Scientist Office for NHS Scotland	Explanation of nature of the questionnaire	Pilot of study instruments. Friedman's test indicated a significant difference between the three assessments.	High

Table 3.3 Quality assessment of the research studies included in the systematic review. Study quality was categorised based on the content and reporting of the studies across the items of tables 3.2 and 3.3. This used a double review process with study supervisors. Low studies were typically small scale or brief in their reporting with a focus away from evaluation but on the technology; medium quality studies were more useful studies that were largely complete in their report with some limitations of methods or quality; high quality studies met all of the quality assessment criteria and were clear in the reporting of their findings.

3.4.3 Thematic analysis

The results of the eight studies were thematically analysed, with the aid of *NVIVO 11*. Four themes all relating to VP outcomes were identified in the findings of the studies: knowledge and skills (including competency and ability); confidence; engagement with learning; and, satisfaction.

Knowledge and skills

All of the eight studies incorporated some knowledge and/or skills assessment. Zlotos *et al.*, measured knowledge changes after VP use by overtly measuring students knowledge. Findings established a significant change post-VP (median scores across two topics were 14 pre-test, interquartile range (IQR) 12-16 and 19 post-test, IQR 17-20; P<0.001). This decreased after six months, but was higher than pre-VP (median at 6 months 16, IQR 14-17; P<0.05) (Zlotos *et al.* 2016). In contrast, the study by Bindoff *et al*., found an insignificant knowledge improvement between intervention groups and pre- and post-VP use (Bindoff *et al.* 2014). Although there was a significant increase in self-measured counselling competency between groups (mean difference in pre- and post-self-rated competencies computer vs paper group 0.9, 95% CI 0.3-1.6; P=0.005) and the VP may have increased perception of counselling ability (Bindoff *et al.* 2014). These studies reported conflicting knowledge outcomes although Bindoff *et al*.'s, participants still percieved a value in VP use. This is similar to Zary *et al.*, who reported that the VP helped students to identify knowledge gaps and motivated them in the acquisition of knowledge, although this was not measured (Zary *et al.* 2006).

In the work by Taglieri *et al.*, participant performance in conducting mock patient interactions was an outcome and participant performance improved after VP use (control 45.18%, intervention 53.19%; P<0.001) (Taglieri *et al.* 2017). The authors discussed that a purpose of their VP was to enable reflection on performance and to apply skills and knowledge (Taglieri *et al.* 2017). This juxtaposes the participants who themselves did not perceive the VP as helpful

for improving performance. Participants did find the VP useful for understanding how to ask patients questions (Taglieri *et al.* 2017). Similarly, Douglass *et al.*, assessed clinical-competency skills in drug-therapy problems post-VP use using standardised patient interactions. There was rigorous development of a competency checklist which included a quality assurance process. Student performance improved by 12% across the study (Douglass *et al.* 2013). This outcome was a useful measure, possibly more so than overtly testing knowledge as a clear value was demonstrated, although like in the study by Taglieri *et al.*, participant perspectives may have also helped to contribute to further establishing the VP's worth.

Further considering participant performance, Fleming *et al.*, showed significantly greater performance in excessive alcohol consumption screening and referral after VP use over six months (improvement in screening, control 3.7%; standard deviation (SD) 19.2 vs experimental 14.4%; SD 16.2). Whilst the VP may have statistically improved participants' screening skills there is no evidence of an improvement in problem-solving, communication, and professional skills, as eluded to by the authors (Fleming *et al.* 2009).

The work by Shoemaker *et al.* used a VP to facilitate an interprofessional educational activity, it measured competency using elements of two recognised scales (Interprofessional education collaborative and Readiness for Interprofessional Learning Scale) to consider interprofessional competency and communication. Results favoured the VP compared to a control (improvement on four out of five questions measuring communication: OR=20.18, P=0.000; OR=7.22, P=0.002; OR=4.64, P=0.012; OR=3.60, P=0.027) (Shoemaker *et al.* 2015). Although the value of the VP to the user is unknown.

Confidence

Two studies assessed confidence among particular elements of participant knowledge and/or competence (Zlotos *et al.* 2016, Taglieri *et al.* 2017). Zlotos *et al.*, reported increased

participant confidence immediately after using the VP (Wilcoxon's signed rank Z=8.6, P<0.0001), which appeared to be maintained after six months albeit self-assessed (Zlotos *et al.* 2016).

In the study by Taglieri *et al.*, results were varied as both increased and decreased confidence were identified across different VP cases. Confidence decreased after initial pulmonary modules (P=0.001) but increased to baseline after later cardiovascular modules (no significant change pre to post, P=5.209). This is also true for particular elements of the cases, for example, confidence in conducting a drug history (Pre-VP 85.8, post-pulmonary VP 79; P<0.001. Post all VPs 85.3; P=0.88). Despite this, participant numbers also declined by over 40% across the study (296 to 122) and changes in confidence were ultimately not significant (P=0.209) additionally SD of results were not reported across this study (Taglieri *et al.* 2017). In this case, a quantitative measure of confidence resulted in confusion and participant perspectives may have helped to explain statistical findings.

It is not clear if VPs are better than alternatives, but some knowledge and confidence changes may occur, and VPs may lend themselves to skill-based applications. It is worth highlighting that measuring confidence can be conflicting and a new approach to this may be required. This may be because confidence can be subjective with no recognised measurement.

Engagement with learning

Elements of experiential learning occurred throughout the studies; Zlotos *et al.,* demonstrated that VPs can test clinical and ethical decision making, and allow users to see the consequences of decisions (Zlotos *et al.* 2016). Similarly, Loke *et al,* stated that students can ''live through the consequences of their actions'' (Loke *et al.* 2011). Students identified with the VP as a real patient, felt responsible for the outcomes of the case and were able to see the consequences of actions (Loke *et al.* 2011). This was similar to Zary *et al.*, who discussed VP use for the

repetitive and deliberate practice of skills in a safe and less stressful environment than with a real patient (Zary *et al.* 2006). Likewise, Zlotos *et al.,* identified that VPs allow for an opportunity to appreciate challenges associated with interacting with patients which students would not necessarily interact with in practice. Their simulation involved substance misusers (Zlotos *et al.* 2016).

Educational uses of the VPs varied by the designs of the VP and by the participants of the studies. Bindoff *et al*., highlighted VP use for contexualisation of learning and further supported VP use to learn from mistakes, this included experiential learning around how to frame questions (Bindoff *et al.* 2014). The study by Loke *et al,* supports this as participants were driven to complete the case by the tasks presented rather than by generic, pre-defined steps (Loke *et al.* 2011). A novel discussion within the study by Taglieri *et al.*'s, concerned time limits for VP use. This appeared to be counterproductive to learning and demonstrated the closely linked nature of VP design and educational outcomes, it is not clear if this was rectified when the time limit for VP use was removed (Taglieri *et al.* 2017). The study also suggested that increased familiarity with the technology can improve learning (Taglieri *et al.* 2017). This is reasonable given the interwoven features of the technology.

All of the studies of this review evaluated VPs within formal educational programmes, the majority being undergraduate courses. Each VP appeared to be specific to its own application and thus direct comparisons of the educational value of the applications are limited.

Satisfaction

A third of the studies identified that VPs need to be available without specialist computers or software (Zary *et al.* 2006, Bindoff *et al.* 2014, Zlotos *et al.* 2016) and VPs should be accessible ''anytime anywhere'' (Zary *et al.* 2006). But, across the studies, a number of technical difficulties which impacted outcomes were reported.

In the studies by Zlotos *et al.*, Bindoff *et al*., Taglieri *et al.*, and Douglass *et al.*, significant technical difficulties were reported by the users. Technical difficulties and issues with technical design appear to limit use, these studies demonstrated the need for usable technology from the user's perspective. Technological issues included 'glitches' that potentially impacted performance and competency (Douglass *et al.* 2013), and problems with game navigation (Bindoff *et al.* 2014).

Two studies discussed VP accessibility. Shoemaker *et al.*, stated that they had actively chosen technology so that the VP could ''run on a wider variety of computer specifications without the need for the latest graphics card technology'' (Shoemaker *et al.* 2015). Bindoff *et al*., identified an advantage of their system was its accessibility and usability on the most common web-browsers (Bindoff *et al.* 2014). These designs were not evaluated in either study and there are no data to support these decisions.

Three studies explicitly measured or addressed technology satisfaction, and all reported positive findings (Douglass *et al.* 2013, Bindoff *et al.* 2014, Taglieri *et al.* 2017). Douglass *et al.*, had clear results concerning pharmacy student enjoyment when using the VP (85% support) (Douglass *et al.* 2013). Two studies commented on VP use compared to paper-based alternatives (Zary *et al.* 2006, Bindoff *et al.* 2014), although the findings by Bindoff *et al*., varied across different pharmacy student cohorts which made it difficult to interpret if the VP was truly more enjoyable (Bindoff *et al.* 2014). The participants in the study by Zary *et al.,* found the VP more engaging than paper-based alternatives (*I found the cases in Web-SP engaging 1= strongly disagree, 6 = strongly agree,* mean=4 IQR 3-5; n=10) (Zary *et al.* 2006).

Finally, Taglieri *et al.*, discussed that their technology, despite being easy to use and realistic, had a decrease in its perceived helpfulness by students across the study (84.8 and 78.4 pre-study and 73.8 and 58.2 post-study for two helpfulness questions; $P<0.001$, no SD reported)

(Taglieri *et al.* 2017). This suggests that even when the developers believe that the technology is useable the users may have different perceptions.

3.5 Discussion

The key findings of this systematic narrative review are that although the VPs in the studies had varied applications there were similarities in that they were found to improve users' knowledge, confidence, skills, and competency. The majority of the studies were not high-quality evaluations and thus should be interpreted with caution especially as a number of studies reported conflicting findings within their own results (Fleming *et al.* 2009, Bindoff *et al.* 2014, Taglieri *et al.* 2017). Some studies did not demonstrate that VP use resulted in statistically significant changes in performance but the VPs still appeared to be useful, with user benefits.

Multiple studies commented on a VP purpose as allowing an opportunity for practice, an advantage of VPs well discussed in the literature (Maran and Glavin 2003, Cook and Triola 2009, Crea 2011, Georg and Zary 2014). Whatever the purpose of VPs, two particular benefits are that they can provide richly contextualised learning applied to practice, but in such a way that the user can safely learn from mistakes. This is in line with ideas of experiential learning where the focus is on learner-driven investigations, often in pursuit of a real or artificial task (Rieman 1996). Similarly, when using VPs as an experiential learning resource users are in an active learning environment where they are able to formulate their own learning through inquiry, problem-solving and discovery (Njoo and Jong 1993). This was explicitly referred to in some of the review studies (Zary *et al.* 2006, Loke *et al.* 2011, Bindoff *et al.* 2014). This also links to ideas concerning reflective based learning and the importance of experiences within learning (Zigmont *et al.* 2011). VPs are able to provide new and safe experiences for users and putting learners in control helps users to refine mental models of a task or experience (Zigmont *et al.* 2011). VPs can also allow the user to self-regulate their own learning and focus

on personal learning objectives. But, in order for new VPs to be a useful experience, a level of knowledge regarding experiential learning is required by the facilitators and designers (Zigmont *et al.* 2011). By using VP there is an opportunity to simulate a clinical scenario and for the user to practice, build confidence and increase accuracy (Crea 2011). Accessible, standardised, safe and reliable practice opportunities are the benefits of VPs reported in some manner consistently across all of the studies.

The majority of studies reported positive satisfaction with VPs, despite some limited delivery and usability. This was important to the outcomes of the studies and some studies cited technological difficulties; this needs to be considered in future VP development and implementation. The technology must be accessible, and easy to use and maintain, as discussed in one study that concluded there should be a level of functional technology in order for VPs to be beneficial (Tan *et al.* 2010). Similarly, there may be increased VP utilisation and implementation when more applications are developed due to a better understanding of the technology (Ellaway *et al.* 2009). The place of the VP within a curriculum should be carefully considered in future evaluations. It is important throughout the VP design process that educational principles are applied to ensure that the VP is of high educational value. This has been suggested in other VP studies including those for other purposes and use in different professions (Guise, Chambers, Conradi, *et al.* 2012, Shah *et al.* 2012, Bateman *et al.* 2013, Georg and Zary 2014).

As delivery issues can distract from learning (Patel *et al.* 2011), technological delivery of VPs should be well thought out with justifications for decisions which have consequences for user satisfaction and learner outcomes. It is important that functional technology is incorporated into further evaluations alongside robust outcomes. There also needs to be greater detail provided regarding the development of evaluation instruments as this was lacking. The review suggests that VPs are a useful resource for experiential learning, particularly for undergraduates but their role in clinical practice or for pharmacists cannot be inferred.

All of the studies in this review focused on establishing the use of the VPs by measuring set outcomes, similar to the review by Cook *et al.,* who established VPs were useful versus no intervention (Cook *et al.* 2010). There are difficulties with this approach and the subjectivity of measuring outcomes such as confidence; what appears to be absent is research addressing the user-value of such tools. Some qualitative research has been conducted on VPs but these studies have not focused on exploring the user's perspectives and experiences (Zary *et al.* 2006, Loke *et al.* 2011, Thompson *et al.* 2016a). In this way, users may provide a perspective different from that collected when measuring ability and provide valuable insights into the apparently contradictory findings from quantitative studies.

None of the studies included qualified pharmacists, demonstrating a gap in the literature for evaluating VP applications for pharmacists. In the eight review studies, the users, despite not being qualified pharmacists, took on the role of the pharmacist when using the VP. This suggests that VPs are well-suited to simulate a pharmacist's role but VP use has not been directly tested to train qualified pharmacists (Triola *et al.* 2006), this is explored in this research. A previous review highlighted the potential of VPs in graduate settings but this does not appear to have occurred (Jabbur-Lopes *et al.* 2012). An opportunity to use a VP for CPD was discussed in one study and in medicine rather than pharmacy, (Fleming *et al.* 2009). The use of a VP for pharmacy CPD purposes does not appear to have been investigated.

3.5.1 Review limitations and bias

The studies were selected based on their technology, but studies could have been excluded due to an unclear technological description. As already discussed, to minimise this, whole papers were closely scrutinised where clarity was lacking. The review also made every effort to establish the exact nature of the technologies in order to credibly include or exclude studies on the basis of their technology.

To minimise the possibility of missed eligible studies the search strategy was repeated regularly and all studies included in the review had their references screened for additional appropriate studies. Additionally, of the studies included, there was a limited opportunity for direct comparison of findings due to variation in the VP technologies and evaluations.

3.5.2 Implications of the findings

Considering the wider study, the review findings are significant in multiple ways. Firstly, as alluded to across section 1.5, the need for functional technology is essential. The functionality of the VP under evaluation is incorporated into the results in chapters 6 and 7. Additionally, none of the studies focused solely on qualified pharmacists, which supports the need for this VP evaluation study, as it is aimed, in part, at qualified pharmacists. Confidence as an outcome appears to have been as investigated as knowledge and skills, it is important that variation in outcomes are incorporated into further evaluations.

Some VPs testing communication and counselling have proven effective, but this study goes one step further to investigate a VP using more sophisticated technology. There also needs to be more transparency and detailed reporting of the development of instruments used for VP evaluations. Furthermore, the ability to perform a task or skill was a common VP purpose, this will be incorporated into this study as the VP explores NOAC counselling as a skill. The review suggests that VPs are a useful resource for experiential learning, particularly at the undergraduate level but their role in clinical practice or for training qualified pharmacists cannot be inferred from the literature.

A number of the studies included in the review helped to inform the design of the VP evaluation. Only one of the studies linked their findings back to practice (Zlotos *et al.* 2016) which provides a gap in the literature which this study aims to contribute to. Furthermore, as already discussed all of the studies in some way addressed technology satisfaction. As each VP application is highly individualised it appears to be important that each VP evaluation

incorporates a level of satisfaction testing. Considering the methods of the study, the content of a number of studies' instruments were examined for inclusion in this study (Zary *et al.* 2006, Douglass *et al.* 2013, Zlotos *et al.* 2016, Taglieri *et al.* 2017). This was largely the wording and design of questions particularly 'satisfaction' questions and Likert designs; these are further discussed in section 5.4.1. Furthermore the study by Bindoff *et al.* (2014) provided thematic results of question responses, these themes were identified as potentially being relevant to this evaluation and so these areas were incorporated in to the questionnaire and interview guide (section 5.5.1). Named examples of these themes included ''difficult to use'', ''feedback lacked guidance'' and ''bad graphics''. In one of the review studies, some qualitative methods were used where class discussions were recorded and analysed retrospectively. On the basis of these findings there was evidence that users were using the particular VP in different ways (Loke *et al.* 2011). This result appeared to be a novel finding and one which this study aimed to consider. This was included as a discussion point in the interview guide (section 5.5.1).

The results of this review have indicated that there are gaps in understanding around VP use concerning the following which will be addressed within this evaluation.

- User perspectives on the usability and functionality of the VP technology and design;
- The use of the VP by qualified pharmacists as a previously scarcely investigated population;
- How the VP can be educationally beneficial to users particularly around confidence, knowledge and NOAC counselling as a skill.

3.6 Conclusion

This chapter systematically reviewed VP use in Pharmacy from this it is clear that important features in VP use are the usability of the technology, the VP purpose, and audience. VPs testing communication and counselling skills have been shown to be effective for use by pharmacy students, but despite this, individual applications still require evaluation due to the

individuality of the technologies. VPs are an additional valuable resource to develop communication and counselling for pharmacy students; use in other pharmacy populations has not been established. The design of this review was also conversed, including the rationale for the search terms, eligibility criteria, and how research quality was established. Finally, the review highlighted how the findings relate to the wider study.

4 Methodology

4.1 Introduction

This chapter follows on from an in-depth evaluation of the literature on VP use. This chapter discusses the methodology of the research study, particularly the underpinning philosophy and research paradigm. It includes a discussion of reflexivity, validity, and reliability. This chapter aims to provide an overview of the methodology that underpins the research as well as the philosophy of the researcher.

4.2 Study aim and objectives

The aim of the study was to investigate the learner-reported value and acceptance of the VP application (as discussed in section 1.5) for pharmacists and pre-registration trainees. The study objectives were to:

- Explore pharmacist's and pre-registration trainee's reported satisfaction in the usability of the VP.
- Explore and measure the perspectives of pharmacists and pre-registration trainees on the ability and usefulness of the VP to teach NOAC counselling.
- Explore participant's perspectives on how the VP can be incorporated into the education, training and continuing professional development of pharmacists and pre-registration trainees.
- Determine participants' perspectives on the ways in which the VP can be improved.

4.2.1 Summary of the research methodology

The study followed a sequential exploratory mixed methods design using a pragmatic methodology where a sample of pharmacists and pre-registration pharmacists completed a questionnaire which included using the VP. Following an interim analysis, a sample of

respondents from the questionnaire group were selected to undertake a follow-up interview based on the questionnaire results. The results of the two sequential phases were also integrated at the end of the study, this will be further discussed in section 4.4.5.

4.3 Research philosophies and methodologies

4.3.1 Research paradigms

Philosophical stances or paradigms are important in research because differences in beliefs influence our interpretations of reality, our values and our research methodology (Doyle *et al.* 2009). Ultimately, this affects the research questions we ask and the methods selected to answer particular research questions (Morgan 2007). There are multiple definitions and uses of the word paradigm to describe alternative philosophical aspects of research. In this study, a paradigm is defined as a 'worldview' which is made up of a mutually exclusive formulation of reality (ontology), knowledge (epistemology), and how best to learn about the world (methodology) (Guba and Lincoln 2004, Shaw *et al.* 2010).

4.3.2 Quantitative and qualitative research

Broadly, there are two main approaches to research: qualitative and quantitative, and each has distinct beliefs underpinning their use. Quantitative researchers tend to think in terms of a single objective reality and this view underpins their whole approach to quantitative research as they focus on understanding the 'truth' regardless of context, which is also known as positivism (Nicholls 2009a). Conversely, qualitative research tends to be underpinned by the belief that reality is subjective and dependent on context, which can be referred to as constructivism or interpretivism (Nicholls 2009a). There are many other philosophies along the spectrum between these two approaches with many additional sub-types and variations (Nicholls 2009a).

Qualitative research is generally distinct from quantitative research not only by the underpinning ontological beliefs of the researchers but also in the purpose of the research. Quantitative research focuses on measuring and understanding quantifiable measures whereas qualitative research focuses away from quantifiable measures and particularly helps understanding of people's views and perspectives (Dew 2007, Nicholls 2009b). Broadly speaking, qualitative research can include research that is not determined by statistical procedures or means of quantification (Hoepfl 1997). It is recognised to be particularly useful to seek insight, understanding, and exploration; it cannot examine causal determination (Hoepfl 1997). On the other hand, quantitative research is able to address these issues but it is not generally recognised to be able to explore the depth and complexity of phenomena, especially social inferences (Hoepfl 1997). On this basis, it is important that when choosing a research methodology the researchers consider the aims and purpose of the research alongside worldviews and ontological beliefs.

4.3.3 Pragmatism

Pragmatism is an approach to research that incorporates aspects from both quantitative and qualitative paradigms. The worldview of pragmatists tends to be problem-centered, considering the consequence of actions and real-world implications. Rather than focusing on methodology, it emphasises the significance of the research problem and the need to use any available approach to understand the research question (Johnson and Onwuegbuzie 2004).

Pragmatism follows a pluralistic approach to derive knowledge as it draws on many different philosophies and approaches including both quantitative and qualitative paradigms. When this occurs however there should be a rationale for mixing and merging paradigms that considers the particular research question (Johnson and Onwuegbuzie 2004, Denzin 2010).

When using pragmatism, researchers focus on finding practical solutions to problems within the practical nature of reality (Denzin 2010, Shaw *et al.* 2010). Pragmatic researchers believe

that all research occurs in context and this is where a practical approach to epistemology comes in to play (Morgan 2007, Shaw *et al.* 2010). Johnson and Onwuegbuzie (2007), discuss that a pragmatic philosophy partners well with mixed methods, stating that pragmatism is ''*cognizant, appreciative, and inclusive of local and broader socio-political realities, resources, and needs*''.

Historically, the debate between the paradigms has focused on differences between qualitative and quantitative philosophies rather than similarities, for which there are multiple (Johnson and Onwuegbuzie 2004, Onwuegbuzie and Leech 2005). In one extreme, it has been argued that 'pure' methodologies are theoretical illusions and that all methodologies have a degree of being mixed (Onwuegbuzie 2010).

Considering in further detail the potential conflicting methodologies which are to be mixed in this study. In using pragmatism, the underlying methodologies typically associated with the chosen methods are not dismissed as dichotomous but rather can be described as *dimensionally different* (Johnson and Onwuegbuzie 2007). Willems and Raush (1969), accessed via Onwuegbuzie and Leech (2005), discuss this in terms of the research using a bi-focal lense whereby pragmatic researchers are able to *zoom in* to microscopic detail or to *zoom out* to indefinite scope (Willems and Raush 1969). The use of pragmatism and mixed methods can be used a philosophy and method which aims to merge together the insights provided by qualitative and quantitative research into a ''workable solution'' (Johnson and Onwuegbuzie 2004); they should be seen as complimentrary rather than as rivals (Jick 1979).

4.3.4 Mixed methods

Teddlie and Tashakkori (2009), are two pragmatic researchers using mixed methods and they state that most mixed methods researchers work primarily within a pragmatic paradigm. This is the case for this research team as a pragmatic, mixed methods methodology was adopted throughout this study.

There are many reasons for using mixed methods including where a single approach is inadequate to provide data on multiple perspectives and with the understanding desired (Doyle *et al.* 2009). Furthermore, researchers may want to contextualise findings, view problems from multiple perspectives, or provide complementary or illustrative context (Meissner *et al.* 2011). Another strong reason for mixed methods research is so that one data set can build on another in a sequential fashion (Meissner *et al.* 2011), which was the approach adopted in this study.

Recognised disadvantages of mixed methods include that the research team requires an appropriate level of knowledge of the methods that are to be mixed and also the familiarity of how to merge them (Doyle *et al.* 2009). To minimise this mixed methods research should combine qualitative and quantitative elements so that the strengths of the two disciplines are complementary with nonoverlapping weaknesses (Johnson and Onwuegbuzie 2007). In this study the lead investigator (CR) underwent research methods training to gain knowledge and understanding of conducting mixed methods research.

Mixed methods research can address a range of questions both confirmatory and exploratory in nature and there is a greater opportunity for a larger assortment of divergent views than with some single method approaches (Teddlie and Tashakkori 2009). The use of two or more methods, such as questionnaires and interviews can give stronger understanding as one type of data provides insight into the extent of views and variables, and the other provides depth into understanding more of the variables, and together they yield useful results that would not be established with a single method (Teddlie and Tashakkori 2009), this approach is adopted in this evaluation. Johnson and Onwuegbuzie (2007), summarise this stating that mixed methods is a powerful choice that will often ‘’provide the most informative, complete, balanced, and useful research results.’’ (Johnson and Onwuegbuzie 2007).

A further reason that some researchers may choose to use mixed methods is becuase the method can offer the chance to triangulate data. Triangulation can be defined as:

> ''*The use of more than one method or source of data in the study of a social phenomenon so that findings may be cross-checked."* (Bryman 2016).

Commonly multiple methods are used in triangulation for the purpose of producing a more accurate, comprehensive and objective representation of a study (Silverman 2014). It can also be used as a technique for 'confirming' results or in mixed methods as a way of merging data (Mays and Pope 2000, Teddlie and Tashakkori 2009). Additionally, triangulation can help to identify patterns of convergence in order to corroborate findings and gain a better overall interpretation of study data (Mays and Pope 2000).

Triangulation closely links with ontology as qualitative researchers tend to not believe in a single objective reality, in this study this meant that close attention was paid to context when using triangulation, in line with a pragmatic methodology. This involved using multiple methods to measure and address different elements of the research objectives and triangulating to establish a more comprehensive overview of the research topic. This approach to triangulation is supported by Morse (2015), who argued that as multiple methods use different perspectives this will not necessarily give the same results but, as different understandings can be gained through the use of different methods, the overall scope and depth of the study is enhanced. This method is also supported elsewhere in the literature where it has been suggested that triangulation not be used solely for testing validity but rather to encourage comprehensive research via allowing unexpected results to be addressed as to strengthen and merge findings (Teddlie and Tashakkori 2009, Morse 2015).

Triangulation can help contribute to the validity of research but it is not a measure of validity alone and additional validity measures should be used to help to ensure comprehensiveness

and encourage reflexivity by the researchers (Mays and Pope 2000, Cameron 2009). This was adopted in this study and further discussed section 4.5.2.

4.4 Mixed Methods in this study

This research used mixed methods as its adopted methodology using a pragmatic approach and research paradigm. Due to the nature of the study aim and objectives, a single method alone was not appropriate to answer the research question and because of this, mixed methods and pragmatism was a well-suited research methodology and paradigm to adopt.

4.4.1 Sequential exploratory mixed methods

There are broadly two variations of mixed methods: convergent and sequential. Convergent (or parallel) designs include independent simultaneous management of two types of data or methods until integration at the end of the study. Conversely, sequential designs use one type of data or method as the basis for another that follows (Cameron 2009). This study used the latter of these designs, specifically, a sequential exploratory design in which qualitative and quantitative phases had equal standing (QUAN → QUAL) (Teddlie and Tashakkori 2006). The quantitative phase used questionnaires and the qualitative phase used interviews as their methods. Considering the sequential nature of the study design, QUAN → QUAL was decided upon as the use of a qualitative design for the latter phase allowed further exploration of data collected in the first quantitative phase. This would have not been possible had the qualitative phase come first followed by the quantitative phase.

Advantages of a sequential explanatory design include the straightforwardness of the design and the opportunity for further exploration of findings, particularly unexpected results. Studies using this design typically unfold at a slower rate and more predictably than convergent designs and so they can be easier to manage (Teddlie and Tashakkori 2006). Whereas a convergent design has multiple disadvantages including that it may be particularly

difficult for new or inexperienced researchers as it involves simultaneous management of two data strands, and problems can occur when data sets do not agree or where there are inconsistencies (Teddlie and Tashakkori 2006). A sequential design remained more advantageous than a convergent design especially as the former provided the opportunity to explore unexpected findings.

4.4.2 Quantitative questionnaire survey

The first stage of the sequential study used a quantitative questionnaire. Questionnaires are frequently used in mixed methods research and are often used to collect quantitative data, but they can make use of a variety of styles and delivery (Johnson and Turner 2003). Questionnaires were selected to gather quantitative data from a large sample because of their advantages and suitability to gather insight into the range of views and variables.

Questionnaires have traditionally been conducted via post, in person, or via telephone, but there is an increasing number conducted via the internet (Granello and Wheaton 2004). Web-based questionnaires have advantages including reduced completion and analysis time, less cost and increased format flexibility, especially when compared with non-internet methods. Disadvantages include difficulties obtaining representative samples, low response rates and technological problems (Granello and Wheaton 2004). Some of these disadvantages could be overcome considering the good standard of technology that is used to conduct questionnaires online and that accessibility to online questionnaires is increasingly high (Granello and Wheaton 2004). More general advantages of questionnaires include the ease of participant anonymity, the ease of data management and that questionnaires are recognised to be good for measuring attitudes (Johnson and Turner 2003).

Studies have repeatedly investigated the use of VPs to change various elements of knowledge and ability (Battaglia *et al.* 2012, Douglass *et al.* 2013, Al-Dahir *et al.* 2014, Bindoff *et al.* 2014, Smith *et al.* 2014, Zlotos *et al.* 2016, Thompson *et al.* 2017). It is partly because of this being

repeatedly investigated with similar findings that this study did not use a knowledge test as a method of measuring knowledge changes. Additionally, the studies also reported some difficulties in measuring these outcomes due to subjectivity as discussed in the systematic review (section 3.5). Instead, the study adopted an approach focused on the perspectives of users on VP use. This included perceived usability, satisfaction, and self-reported ability changes, in line with the research aim of the study (section 4.2) and of the VP design (section 1.5). This approach to the research also meant that it was not necessary to use a control group. The premise of the study was not to prove the efficacy of the VP versus other methods but to inform the learner reported value and acceptance of the VP and to explore perspectives with a focus on real-life considerations for practice.

4.4.3 Sequentially moving between methods

Moving between two methods and their associated methodologies can be difficult and an area of conflict concerns how to select samples for mixed methods research (Teddlie and Tashakkori 2009). Particularly as it can be difficult to merge different types of samples and problems arise when there is disagreement (Creswell and Clark 2010).

Mixed methods sampling focuses on generating a sample to address a particular research question, this is in keeping with the pragmatic approach of centralising the research question throughout the research (Teddlie and Tashakkori 2009). A guideline for mixed-method sampling by Teddlie and Tashakkori (2009) describes eight sampling stages, something broadly adopted in this study (Figure ***4.1***). Through using this guideline, the sampling strategy for the study was able to make use of sampling methods for each phase which were already recognised within their own disciplines.

Guidelines for Mixed Methods Sampling

1. Your sampling strategy should stem logically from the research questions and hypotheses being addressed by the study.
2. You should be sure to follow the assumptions of the probability and purposive sampling techniques that you are using.
3. Your sampling strategy should generate thorough QUAL and QUAN databases on the research questions under study.
4. Your sampling strategy should allow you to draw clear inferences from both the QUAL and the QUAN data.
5. Your sampling strategy must be ethical.
6. Your sampling strategy should be feasible and efficient.
7. Your sampling strategy should allow the research team to transfer or generalise the conclusions of their study to other individuals, groups, contexts, and so forth.
8. You should describe your sampling strategy in enough detail so that other investigations can understand it and perhaps use it in future studies.

Figure 4.1 Principles of mixed methods sampling (Teddlie and Tashakkori 2009)

Teddlie and Tashakkori further explored the rationale for different sampling methods: quantitative methods often focus on representativeness and qualitative on information-rich understanding or meaning of cases, in mixed methods a balance of the two may be required and this was incorporated into this research (Teddlie and Tashakkori 2009). Generalisability can also be an issue in mixed methods sampling as quantitative methods often focus on external validity whereas qualitative methods focus on transferability and again, a unique balance may be needed (Teddlie and Tashakkori 2009). It is for this reason that the two phases of the study, each with different designs and purposes, used their own recognised sampling methods which are discussed in section 5.3.

4.4.4 Qualitative interviews

The second method of data collection used in this study and one commonly matched with questionnaires in mixed methods is that of interviews (Johnson and Turner 2003). Interviews, like questionnaires, can contrast in structure and design. In this study, the interviews used a semi-structured approach, which allowed for some topics to be pre-defined but equally, freedom to explore emerging topics (Johnson and Turner 2003). To some degree all interviews have a degree of structure, in the same way that a conversation does (DiCicco-Bloom and Crabtree 2006), therefore the term 'semi-structured' is a fluid definition that can mean different things. Throughout this research, semi-structured refers to an interview whereby open questions are asked to elicit narratives and stories, the interviewer asks questions but contributes little else to the interview, instead, it allows the interviewee to talk, as discussed by Whiting (2008) and DiCicco-Bloom and Crabtree (2006).

Qualitative interviews have been chosen as they are recognised to be good for exploring participant attitudes, they have the ability to provide in-depth data and they are useful for getting insight into ideas and themes (Johnson and Turner 2003). This advantage means that interviews are well suited to be used as a follow-up after questionnaires to explore issues in the data further and confirm the intended interpretation of findings.

Additionally, the use of interviews as one of the multiple methods of the study was anticipated to contribute to answering the research question. Through using mixed methods, specifically a mixture of interviews and questionnaires, the study's objectives could be met, and the results could be strengthened and explored in more depth to better address the research aim. As discussed in section 3.5.2, one of the implications for the systematic review findings were to consider alternative methods of measuring the user-value of VPs without measuring set knowledge or confidence outcomes; this has been considered through the design of this study.

Telephone interviews (TIs) and video interviews (VIs), such as Skype, were offered as an alternative to face-to-face interviews (FFIs) where there were difficulties with organising the latter, for instance where geographical limitations applied. It was hoped that this would help recruitment for the interview phase as VIs and TIs may be an easier option for some participants and they are an alternative should an FFI not be possible. A major advantage to VIs and TIs is that of safety, as the interview takes place in a comfortable environment for the interviewee and they may be more likely to talk freely and honestly (Hanna 2012, Janghorban *et al.* 2014, Oates 2015). Furthermore, rapport can also be built as would be in an FFI (Novick 2008, Oates 2015), however, VIs, TIs, and FFIs can differ in the way in which the participant is presented as body language and non-verbal observations are missed, particularly during TIs (Novick 2008, Janghorban *et al.* 2014). Despite this, TIs are still recognised to be useful and have even been shown to be as effective as FFIs in terms of the data retrieved (Colombotos 1969, Novick 2008, Cachia and Millward 2011). A pragmatic approach to using Vis and TIs was adopted throughout the research.

In qualitative research, researchers have an inherent effect on the interview and a process of reflexivity is required to acknolwedge the effects of the researcher on the interview and consider the signifance of this (Whiting 2008), as discussed in section 4.5.4. General disadvantages of interviews include that they can have low participant anonymity and in some studies this can be a disadvantage especially where sensitive or emotional topics are discussed (Whiting 2008, Janghorban *et al.* 2014). In this study, the topic was not sensitive and so it was anticipated that participant anonymity concerns would be low; nonetheless during the consent processes participants were assured of anonymity.

4.4.5 Integration of the methods

Integration of mixed data is an important element when defining a mixed methods study particularly as the method and place of integration can differ (Bazeley 2003). Fielding (2012),

states that data within a mixed methods study needs to be integrated for three reasons: illustration, convergent validity or triangulation, and for the development of ''richness''. Within this study, the purpose of data integration was firstly triangulation or the convergence and corroboration of the results, but also secondly complementarity in an attempt to improve completeness or comprehensiveness of the data (Bryman 2006).

Methods for integration can vary. Simple integration involves the transformation of one type of data so it can be used in conjunction with another such as using demographic data to provide context to qualitative data, whereas complex integration can use computer programmes to assist analysis (Bazeley 2003). In this study, the two phases were initially analysed separately each using their own recognised methods. This was followed by an integrated interpretation. The two sets of data were used in a confirmatory fashion to further explore and understand the ideas presented in each (Bryman 2006). As stated by Jick (1979), as well as the benefits of triangulation from a validity perspective, more broadly speaking it can also ''*capture a more complete, holistic, and contextual portrayal of the unit(s) under study*''. This is one way in which triangulation was used in this study.

Within the literature there is a recognition that the process of integrating data, particularly triangulation is somewhat clouded in mystery, with processes and methods unclear (Jick 1979, Bryman 2006, Fielding 2012). Jick (1979), explored that a triangulating researcher may somewhat rely on their feelings of the data during integration and that they are builder and creator piecing together the pieces of a puzzle. This highlights the significant role that reflexivity (sections 4.5.4 and 10.6) plays in the process of data analysis in a mixed methods study. This should be considered alongside the following description of how data integration was conducted in this study.

Initially the data collected in phase one informed the questions and topic areas discussed in the interviews as a way of corroborating findings from the first phase (section 5.5.1). For

example, if a topic was mentioned in the questionnaire but was unclear or lacked detail then this was explored further in the interviews. The same occurred for significant or unexpected findings. This will be discussed, with examples, in section 10.2.1. This additionally contributed to triangulation via directly exploring specific topics in more detail and gathering data from a range of participants.

Furthermore, during data interpretation, the two data sets were used to identify any similarities or differences between the two with the aim of using one dataset to support and explain the other, in line with a corroborative approach to integration. The two data sets allowed for a comparison of the reported usefulness and usability of the VP in a wide group (from the questionnaire phase) alongside individual perspectives on the place of the VP in practice (from the interview phase). As the interview results were socially contingent, these results could be triangulated with the satisfaction and self-reported ability results from the questionnaire to determine if the measured results from the questionnaire matched with participant's reports from the interviews. This provided a deeper understanding of the study results and as discussed in section 4.3.3, this demonstrates the concept of being able to use mixed methods to 'zoom in' to specific results and 'zoom out' for perspective (Willems and Raush 1969).

4.5 Research quality

In using mixed methods assessing quality can be conducted in multiple ways with no single commonly adopted approach (Bryman *et al.* 2008). In this research, Morse's (2015) approach to rigor has been adopted to unify the quantitative and qualitative elements of the study into a single set of quality measures to try to produce research of overall good quality as summarised below.

Quality in quantitative research can be assessed using 'traditional' quality measures such as validity, reliability, and generalisability (Bryman *et al.* 2008). Qualitative research can be

assessed with some of these same broad concepts, but they need to be adapted to consider the distinctive goals of qualitative research (Mays and Pope 2000). Rigour in qualitative research is a widely debated area as some researchers argue that it is not possible to use conventional criteria to assess qualitative research due to differing ontological beliefs (Mays and Pope 2000). One concept that addresses quality in qualitative work is that research must be 'trustworthy' (Guba 1981, Morse 2015). This incorporates ideas of credibility, transferability, and confirmability which include aspects of the more 'traditional' quantitative concepts of validity, generalisability and reflexivity respectively (Guba 1981, Morse 2015). Conflicting with the concept of distinct characteristics of quality in qualitative and quantitative research, the work by Morse (2015) argues that qualitative research should revert to discussing rigour with the 'traditional' approaches on the basis that the newer concepts, conceptualised specifically for qualitative research, have only been critiqued in a limited number of works with questions concerning if they actually contribute to rigor remaining (Morse 2015).

As this this study uses mixed methods, whereby approaches to rigour could conflict, Morse's (2015) approach to rigor has been adopted whereby the 'more traditional' quantitative concepts of reliability, validity, generalisability and along with reflexivity are used for both the quantitative and qualitative elements of this study. This is discussed below where the approaches taken to strengthen the quality of both the quantitative and qualitative phases and of the overall study will be discussed. This is an attempt to pragmatically produce research of overall good quality and rigour (Kitto *et al.* 2008, Braun and Clarke 2013, Morse 2015).

4.5.1 Reliability

Reliability concerns the replicability of study results and it is particularly associated with quantitative paradigms for ontological reasons like those discussed above (Golafshani 2003). It

is not entirely applicable to this study as the nature of qualitative elements, where context is paramount means that replicability is not possible.

Efforts have been taken to increase the replicability of the quantitative methods within the study including the transparent presentation of the recruitment process, sampling strategies and the questionnaire development process. The reliability and validity of the questionnaire instrument were further assessed in the questionnaire development and piloting (section 5.4.2.). A Cronbach alpha test was used to give a statistical indication of the reliability of the Likert scales used in the questionnaire, this is further discussed in section 5.4.2.

Moving to consider the reliability of the qualitative phase, replicability of this phase of the research is not possible as individuality is valued. Despite this, efforts have been made to ensure that the research is 'trustworthy'; the work by Morse (2015), has guided the approach to qualitative reliability as follows. Morse (2015) explains the concept of a 'thick description' as a way to contribute to internal reliability on the basis that plentiful data overlap and this allows the researcher to see replication, this therefore verifies the data set internally (Morse 2015), although thick description is an area of debate and at times confusion. The work by Ponterotto (2006) explores this in detail and positions thick description as the roots of a tree that nourishes the trunk and leaves, or the interpretation and meaning respectively (Ponterotto 2006).

Additionally, the reliability of the interview guide was addressed in an interview pilot to explore if questions were understood in a similar way and so answers could be coded without uncertainty. This is a recognised method to test interview instruments and was used in addition to the thorough training of researchers (Silverman 2014). A further approach to optimise the reliability of the whole of the research was to address that the researcher and the research instruments may be a source of bias (Braun and Clarke 2013). This was incorporated into the study via reflexivity as is discussed in section 4.5.4.

4.5.2 Validity

Approaches to improve validity consider if the measurements of a study are accurate or well-founded, and if they measure the intended (Golafshani 2003). Validity can be broken down into multiple sub-types some of which will be discussed in this section. Morse (2015), highlights that validity enables theories from research to be generalisable and this is useful when these theories are recontextualised and applied in other settings.

Concerning the quantitative phase of the research, three types of validity were considered as follows. Construct validity assesses whether an instrument measures what it aims to and if the measurements are representative of what the study is trying to investigate in a wider context (Braun and Clarke 2013). This was considered in the instrument development to ensure that the questionnaire measured what it was intended to and that the data collected was usable considering the research question. Similar considerations were made for the interview guide. Face validity was also considered in the piloting of the questionnaire. This assessed if the content of the questionnaire reflected the subject matter and was accurate and complete (Scott and Mazhindu 2014). Finally, content validity or the representativeness of questions, was assessed, to a certain degree, by the literature review which included assessing the content of questionnaires used in other studies (Scott and Mazhindu 2014).

Moving to consider the qualitative approaches to validity, Morse (2015) presented a critique of common validity approaches and tools to summarise which are useful and relevant to qualitative research. As was discussed in section 4.5.1 but in the context of reliability, thick description of data can contribute to the quality of research. This is also true for validity. Morse (2015), details this in the context of a study sample and how this can contribute to the validity of a research study. This is further discussed in section 5.3. Similarly, Morse (2015), also discusses researcher bias or reflexivity as being important for the validity of a study. This is also discussed separately in section 4.5.4.

The next approach discussed by Morse (2015), is that of triangulation. This has already been discussed in the context of mixed methods (section 4.4.5) but considering this from a validity point of view specifically, Morse (2015), states that triangulation can be useful to increase the scope or depth of a study. Although, this is only really useful in studies using multiple methods, whereby two methods each contribute their own data which could not be collected from the other method alone. Triangulation, therefore, in this study, does contribute to validity as it is used as part of a mixed methods study to enhance understanding.

Similarly, negative case analysis is a closely related concept which can be useful to reveal important differences in data and help critical analysis and understanding of a concept. This in turn, helps to develop validity in a research study. This is something that was incorporated into this study as is discussed in section 6.11.2 and 10.2.1 whereby any data that was contradictory from majority views were identified and discussed, as this helps to refine an ongoing analysis (Mays and Pope 2000).

Finally, respondent validation or member checking uses participants to validate the study findings and establishes if findings conform to an individual's experiences (Silverman 2014, Morse 2015). Qualitative research is highly contextual and each participant is recognised to have their own individualised view and thus there can be difficulties with determining the credibility of findings as this can often result in further confusion rather than confirmation (Johnson and Waterfield 2004). This method of validation relies on a degree of belief in a fixed 'truth' and as context is paramount, respondent validation was not used, this is as recommended by Johnson and Waterfield (2004) and Morse (2015).

4.5.3 Generalisability

Generalisability is a form of external validity and relates to the extent to which the results of a study can be applied to a wider or different population (Braun and Clarke 2013). Morse (2015), presents an approach for qualitative research to embrace generalisability on the basis that

validity enables qualitative theories to be generalisable when the theories are recontextualised and applied in different settings (Morse 2015). Moving to consider the questionnaire phase, it used a sample from a range of different sites across England and had a wider transferability than if the interview phase had been used alone. The generalisability of these results is discussed in section 10.5.

A further approach to contribute to generalisability that was adopted, was to detail the study methods and conduct in such depth that the reader can judge if the findings apply to other settings and contexts for themselves (Guba 1981, Mays and Pope 2000). Furthermore, the study used a sample that best represented those with knowledge of the research topic, in this case, practising pharmacists and pre-registration trainees this is further discussed in section 5.3. Overall these elements contributed to the aim to produce trustworthy, or as Morse, argued generalisable research (Morse 2015).

4.5.4 Reflexivity

Reflexivity concerns the degree to which the research methods, including the researchers themselves, impact the research (Finlay 2010). Reflexivity is traditionally associated with qualitative research whereby researchers cannot be completely objective and remove themselves from the research processes. Personal biases and opinions need to be transparent in order to enhance the credibility of findings (Mays and Pope 2000). Braun and Clarke (2013) summarise this as:

> *"…the process of critically reflecting on the knowledge we produce, and our role in producing that knowledge."* (Braun and Clarke 2013).

To consider this, researchers engage in self-reflection and awareness of their circumstances and opinions to consider how this impacts the research (Finlay 2010). An additional level of awareness is required by healthcare researchers as interviews present a conflicting

relationship between research and professional identify. Richards and Emslie (2000), demonstrated this when they compared data from interviews conducted by a medical doctor and a sociologist. The results of the study demonstrate that interviewee's perceptions of who the interviewer was did influence the interactions of the interview (Richards and Emslie 2000). An example of how this was considered in the study was that the researchers were pharmacists investigating other pharmacists. This needed to be transparent so that the participants could talk to the interviewer as a peer as opposed to a researcher or superior.

A further example is that the chief researcher did not design the VP but was impartially evaluating the VP. This was made transparent to participants at the start of the interviews as it was hoped that this would allow participants give a more honest view of VP use and reduce any bias resulting from the participants not wanting to 'offend' the VP design. This is further discussed in section 10.6 alongside a more detailed application of reflexivity in this study.

4.6 Summary

This chapter summarised the methodological considerations within this research including considerations as to why the adopted methodology was appropriate. There was a discussion of the appropriateness of the chosen methods to answer the research question and how the methods impacted the quality and significance of the results. The study methodology utilised is that of a pragmatic mixed methods approach. This allowed researchers the freedom to tailor the methods to the research question with a focus on results that are contextualised in practice.

5 Methods

5.1 Introduction

This chapter follows on from a discussion of the study methodology and the underpinning philosophy associated with this research. This chapter will discuss the study instruments and will outline the decisions and processes that were undertaken concerning data collection, data analysis, sampling, and recruitment.

5.2 Overview of study design

The study design is summarised in Figure 5.1. The two, sequential phases are linked via an integrated analysis and also through the analysis from phase one impacting phase two. The methods included in this design will be discussed across this chapter.

5.2.1 Ethical and governance approvals

The study received ethical approval in February 2018 from Keele University (appendix I.), this included a peer review by the project supervisors and two academic pharmacists from the School of Pharmacy. Health Research Authority approval was granted in July 2018 (Appendix II.). Considering participant confidentiality, respondents recorded their name and email address during the consent process (consent forms and participant information sheets (PIS) available in Appendices III. And IV.), this identifiable data was essential to contact participants for interviews and to connect data between the phases. these data were stored in a separate encrypted *Microsoft Excel* spreadsheet. For interviews consent was taken prior to the interview because where video or telephone interviews were used participants could not provide written consent at the time of the interview. Participants made a second verbal consent at the start of the interview following further explanation of the interview process, a method recommended by Oates (2015).

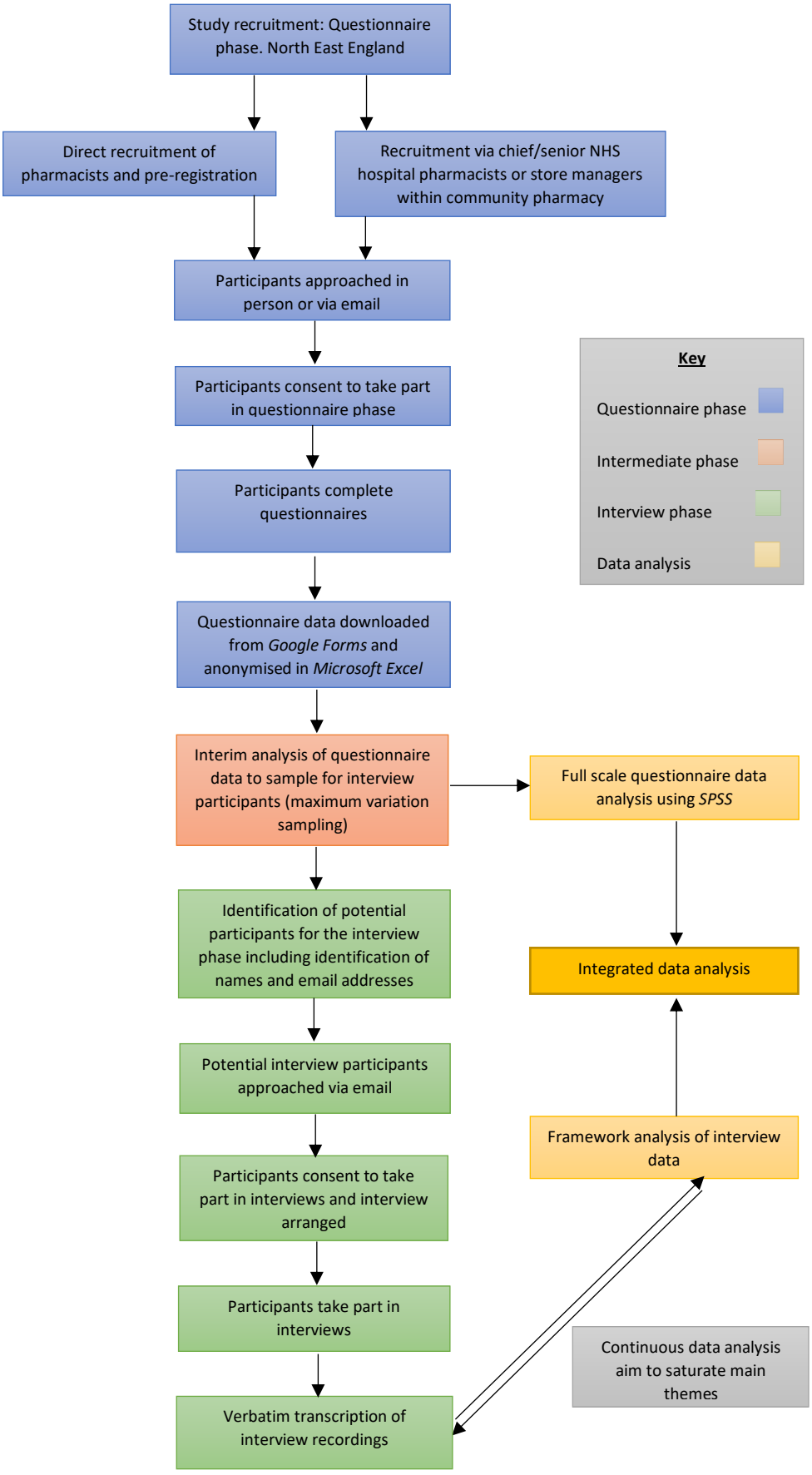

Figure 5.1 The study design and processes

5.3 Sampling and participant recruitment

The following inclusion criteria applied to the study:

- Participants needed to be practising U.K. community or hospital pharmacists or pre-registration pharmacists who wished to undertake an educational training programme on NOAC use in AF because it was relevant to their current, or future, practice or professional development. This inclusion criterion was clear in the recruitment emails and PIS.

The following exclusion criteria applied to the study:

- Pharmacists who were involved in the development of the VP or in the instrument pilots (sections 1.5.3, 5.4.1 and 5.5.1) were not able to participate.
- Pharmacists who work solely in other sectors of pharmacy than community or hospital were excluded from the study.

The study required participants to be practising in U.K. community or hospital sectors as these sectors were considered to be where participants were likely to be conducting NOAC counselling. The VP was intended to be used by pharmacists or pre-registration trainees who felt that it may have relevance to their practise and consequently this was clear in the inclusion criteria, PIS and recruitment emails.

Recruitment for the questionnaire made use of the research team's professional networks. These networks facilitated access to fourteen sites, which included nine hospital sites and five geographical areas of community pharmacies covered by Clinical Research Networks (CRNs). The pharmacy manager or another appropriate senior staff member were asked to distribute the study recruitment email to appropriate staff. It was made clear to participants that their employer was not involved in the research and that their responses were confidential.

Interview participants were directly recruited from the sample of questionnaire respondents (section 5.3). There was no requirement for respondents to take part in the second phase of

the study and the consent process was separate from the first phase. A two-phase sampling method was used to recruit participants for questionnaires and then for interviews.

Recruitment for the questionnaire phase occurred using a largely convenience sampling technique but with some levels of targeting such as getting a mixture of lengths of time since qualification and of sector of practice. Use of a convenience sample is quick, relatively straightforward and non-resource intensive compared to alternative random sampling methods (Flick 2002).

Interview sampling was conducted using a mixture of sampling methods. Morse (2015), explored this approach and discussed that in qualitative research a mixture of sampling methods may be required. Morse stated ''data collection must begin somewhere'' and that initially the data collection may be ''hit and miss'', this is in part due to the fact that all sampling has a level of convenience especially when relevant characteristics or the information which needs to be sought is not known (Morse 2015). In this study, there was a level of convenience sampling as the interview participants were recruited from the earlier questionnaire participants which themselves were recruited to a degree by convenience as discussed previously. However, there was a level of purposive sampling on the basis of the participant's questionnaire results and demographics. Purposive sampling selects the cases which are likely to best contribute to the research question and so this was a suitable where the questionnaire data was used as a basis for interview sampling (Flick 2002). This technique also has an association with pragmatism (Emmel 2013).

Within the study, the stages to conduct this element of sampling were as follows. The questionnaire data underwent a preliminary analysis prior to interview sampling, this explored the questionnaire responses and identified those with particularly interesting and varied opinions, and those with a range of ability changes from using the VP. Following the identification of these participants, demographics were considered to gain a sample of

different genders, ages, length of time since qualification and sectors of practice. The variation of participants was monitored as participants took part in interviews. Despite this, as the participants were taken from the pool of questionnaire participants and thus were finite the sampling strategy involved a level of convenience.

5.3.1 Sample sizes

In mixed methods research sample sizes can be a dilemma as each method uses their own approach and thus the sample need to be guided by the research question (Teddlie and Tashakkori 2009). In this case, the sample sizes were established in reverse because the interview sample drove the sampling and recruitment for the questionnaire phase.

In qualitative research, a term associated with sample sizes is that of data saturation. This can be a problematic concept to define with subjectivity between researchers. Guest *et al.* (2006), defines data saturation as "the point in data collection and analysis when new information produces little or no change to the codebook" and the authors took a numerical approach to exploring data saturation (Guest *et al.* 2006). Conversely, Morse (2015), had a different approach to sampling when they detailed that due to a host of different variables such as the subjectivity of the phenomenon, interview quality and the homogeneity of a sample that attempting to predetermine a sample size is ''a futile task'' (Morse 2015). Fusch and Ness (2015), also discussed this and stated that the process of saturation is not about numbers but rather the depth of the data, is it both *rich* (concerning quality) and *thick* (concerning quantity)? This different idea of richness and thickness encompasses many of the ideals of thick descriptions previously discussed (Section 4.5) (Ponterotto 2006).

Using Guest *et al.'s* (2006) definition of data saturation but Morse's (2015) and Fusch and Ness's (2015) approaches the following methods of data saturation were adopted. As the interview participants in this study were taken from the sample having completed the questionnaire, and thus were of a finite number, a pragmatic approach was adopted when

attempting to reach saturation whereby only key ideas were aimed to be saturated rather than every discussion. There was a focus on determining if the data was both *rich* and *thick*, this, in the context of the data, is discussed in section 5.5.4.

Returning to consider sample sizes, it was estimated that the number of interviews would be 15-25 based on the small number of characteristics which seemed to be relevant to the research question, that the topic was highly specific and the relative homogeneity of the sample. Following this, the questionnaire sample was considered. It needed to be large enough that an appropriate interview sample could be drawn, an approximation for this was 80-100 respondents based on using around a 25% selection process for selecting participants for interview. This sequential approach to sampling is supported by a study discussing the typology of mixed methods sampling (Onwuegbuzie 2007).

5.4 Quantitative data collection and analysis

5.4.1 Questionnaire design

The study questionnaire was designed by the research team and in order to contribute to the quality of the instrument the lead investigator (CR) underwent questionnaire design training and the questionnaire was included in the peer review; following feedback the questionnaire was amended. This helped to contribute to the quality of the instrument and create an instrument using widely recognised 'best practices' (Artino *et al.* 2014).

Google Forms was used for questionnaire distribution, it was chosen because it could support all of the question and could be easily delivered. Data could also be easily managed. The questionnaire contained six demographic questions plus 24 pre-VP questions and 34 post-VP questions (Figure x and Appendix V.). Demographic questions included basic information about the respondent this provided the vital information required for a detailed analysis.

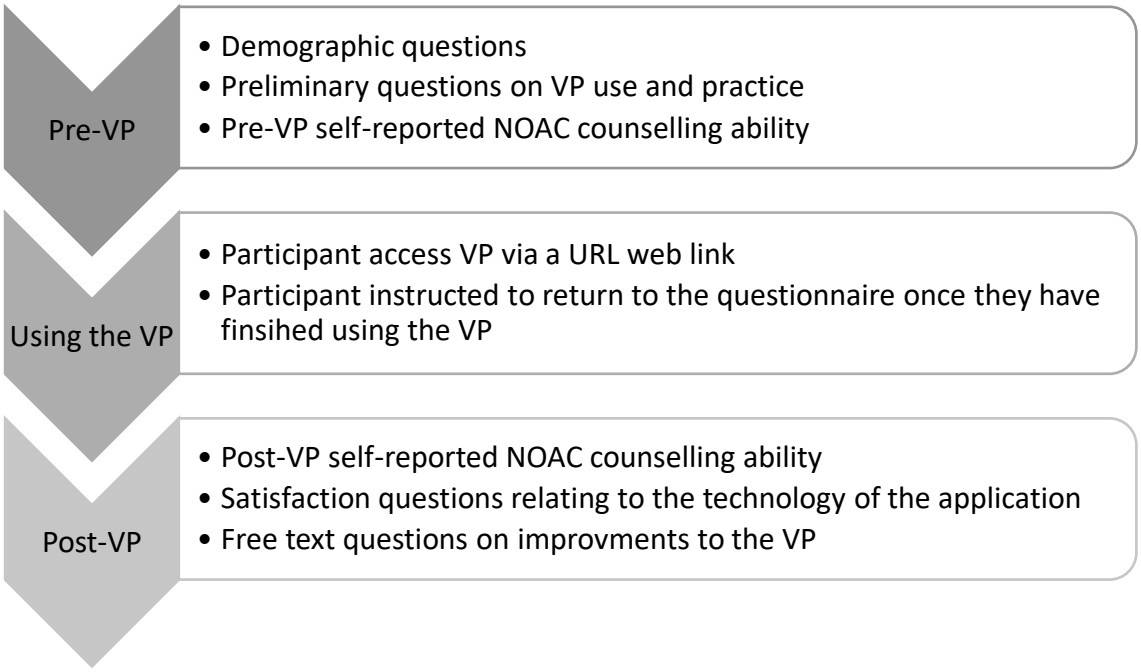

Figure 5.2. The participant's journey when completing the questionnaire. The process took place remotely via a single Google Form

After completing demographics questions and some preliminary questions on self-reported ability on various aspects of NOACs and AF (this area of the questionnaire was based on the NICE guidelines for anticoagulant counselling (National Institute for Health and Care Excellence 2014)) the respondents were presented with an embedded URL link to the VP application, and they were free to use the VP for as long as they wished, around 20 minutes was suggested. Respondents then returned to their questionnaire and completed a series of post-VP questions, this included identical self-reported ability questions as pre-VP.

Other questions were mainly Likert scales using four different scales, there was one ranking question that asked respondents to rank five options from the most to least relevant. There were also seven short-answer free-text qualitative questions, these questions were based on common satisfaction questions from the literature to support further explanation of the Likert responses (Douglass *et al.* 2013, Taglieri *et al.* 2017).

Responder literacy, or the demand on the respondent to understand the questions, was considered in the questionnaire design (Bowling 2005). As a consequence of the respondents all being HCPs, a high level of literacy was anticipated. Nevertheless, the questionnaire format, aesthetics, and wording were designed so that it could be understood by any of the respondents. No specialised wording was used and the terms NOAC and AF were defined within the questionnaire. Motivation for participation was incorporated in the recruitment emails and PIS as it was made clear to potential respondents that they may personally benefit from taking part in the study as they would have access to a novel education tool that may have consequences for their NOAC counselling abilities.

The questionnaire used 5-point Likert scales. This use of scales with a central point has been the subject of much debate since respondents may naturally gravitate to the central point when they do not know an answer or do not want to select one from those provided (Rattray and Jones 2007, Scott and Mazhindu 2014). If a scale has no central point this forces an answer, which can be beneficial when the subject is sensitive or controversial. Conversely, people who are genuinely neutral are not able to select an appropriate option if a central point is absent (Scott and Mazhindu 2014). In this study as there was no reason to remove the central point 5-point scales were used. The questionnaire also used a minimum variety of Likert scales and asked simple questions as this can reduce cognitive load (Lietz 2010).

To reduce acquiescence bias ('yes-saying'/an excess of positive results) (Bowling 2005), the questionnaire included questions with a mixture of positive and negative anchors so it was clear if respondents had repeatedly selected responses of the same axis, as described by Bowling (2005), and Rattray and Jones (2007). This included asking if respondents found the VP useful, comfortable and enjoyable but in reverse, asking if the application was difficult to use. This helped to identify any acquiescence bias as these sets of questions should, in most cases, have opposite results. This in turn contributes to internal reliability (Bowling 2005).

5.4.2 Questionnaire quality

It has been highlighted that there is a lack of considerations for the quality of evaluation instruments (Jabbur-Lopes *et al.* 2012) and quality considerations appear to be absent from many of the studies discussed in chapters 2 and 3. A number of quality considerations have been considered in this study and are discussed below.

Initial reliability testing of the instrument consisted of establishing content and face validity. A review of the questionnaire by people who are experts in the field contributed to addressing content validity (Artino *et al.* 2014). The research team as pharmacists had first-hand knowledge of the construct of interest and they could advise on the questionnaire content and language from the point of view of a respondent; the peer-review also contributed to this. Subsequently, improvements to the questionnaire delivery were made so that it was easy to use, accessible and not overly time-consuming as this has been shown to negatively impact response rates (Rolstad *et al.* 2011).

The draft instrument was piloted, which aimed to test the design and processes of the study, and prepare for data analysis via exploration of which tests would be suitable for use (van Teijlingen and Hundley 2001, Artino *et al.* 2014). A convenient sample of pharmacists from the School of Pharmacy was drawn on, in keeping with the pragmatic approach to this research. To avoid contamination between the pilot and the main study data was managed separately and participants could only take part in either the pilot or main study (Leon *et al.* 2011).

Within the pilot, all parts of the questionnaire data were examined to explore different statistical options for analysis of the data. Broadly, the pilot used the same data collection and analyses as the wider study. Ten participants took part in the pilot phase and data were examined for acquiescence bias. A significant Cronbach alpha result (P=0.917 and 0.865 for pre and post-VP Likert's respectively) demonstrated a high level of internal consistency which in turn suggested that the Likert scales were reliable to be used in the wider study (Tsang *et al.*

2017). The pilot data behaved as expected, suggesting that the questionnaire functioned as intended, and there was also a trend in the data which implied that the respondents understood the questionnaire in a similar way. This increased its reliability for further use. Face validity was also assessed (Tsang *et al.* 2017). This involved using direct participant feedback gathered from the pilot to identify improvements to the delivery, design and overall experience of using and completing the questionnaire.

Following the pilot, minor amendments to the questionnaire content were identified and made. These included grammatical and typographical errors which did not change the purpose or nature of the questions. One ranking question was amended to reverse the ranking scale and to include the correct number of outcomes. This was amended for data analysis purposes and to make the question easier to understand for the respondents..

5.4.3 Data analysis

Questionnaire responses were accessed in *Google Forms* and converted to a *Microsoft Excel* spreadsheet for analysis. The data underwent descriptive analysis incorporating a mixture of SDs and means, and medians and IQR. These were used to establish the nature of the data and its common features and make data interpretable (Scott and Mazhindu 2014).

Further statistical analysis was then undertaken to analyse specific parts of the data. The study collected a mixture of ordinal and nominal data and included both parametric and non-parametric tests (Scott and Mazhindu 2014). In this study, Likert data were analysed using a mixture of parametric tests and means and medians. This depended on whether data were normally distributed and the intended purpose of the question(s) as described below.

During analysis, the questionnaire was split into five sections. Demographic questions were first considered using descriptive statistics to establish and explore the nature of the sample. This was also particularly important for interview sampling. Self-measured ability Likert scales pre- and post-VP were then considered. The Likert items were grouped together into pre- and

post-VP groups, the cumulative and average score for each was calculated, as well as the percentage change. The convergence of multiple scores into one overall score is a recognised method of managing Likert data (Boone and Boone 2012). The grouped data then underwent statistical analysis using paired t-tests to establish whether there was a significant difference between the two sets of scores (Healey 2014). T-tests are a common test and have been widely used, including in VP evaluations (Battaglia *et al.* 2012, Al-Dahir *et al.* 2014). After statistical consultation and considering the nature of the data, t-tests were deemed appropriate as the data was normally distributed. A Kolmogorov-Smirnov test of normal distribution was used to aid this decision making.

The satisfaction questions were analysed using descriptive statistics, specifically calculations of medians and IQRs. Medians were used over means for these questions as the data was ordinal and there was no reason to treat it as interval data. A ranking question with five outcomes was analysed using a Friedman Test that identified whether there was a statistical significance between the responses (Field 2013).

The final questionnaire section consisted of the qualitative free-text questions, these responses were thematically grouped, and the frequencies calculated. This was used to support, explore, and confirm numerical data and also contributed to interview sampling.

5.5 Qualitative data collection and analysis

Interview participants were approached to take part based on their demographics, specifically sector of practice, qualification status, age, gender and likely involvement in NOAC counselling. There were some additional considerations based on participant's questionnaire results namely free text responses and thought-provoking responses and perspectives.

Initial 8 key interview areas
Experiences of AF and NOACs and associated education and training
Experiences of VPs
Feelings towards using VPs
VP as an educational tool
- *Implementation of the VP*
- *Purpose of the VP*
VP technology
- *Improvements to the VP*

Table 5.1 Key topics initially planned for inclusion in the interviews

The study's interview guide was based on the aim and objectives of the study and the review of the literature; the guide (Appendix VI.) was piloted prior to use and contained eight topics to be discussed (Table ***5.1***),. Furthermore, using the questionnaire results, the initial interview guide was adapted and new discussion points were added and development of the discussion topics continued throughout the course of the interviews. Additions included: perspectives on the use of MCQs (question design within the application) and potential alternative designs; the user feedback design; the perceived purpose of the VP; who the best users of the VP are; and considerations for implementation and use in practice.

5.5.1 Interview guide design

Prior to the start of the main study, some interview preparatory work was undertaken to test the proposed interview guide and also to develop a working framework for data anlaysis. This was also useful to contribute to training interviewers (Boyce and Neale 2006). The interview guide was included in the peer review and was then tested in a number of pilot interviews; data were analysed in the same manner as for the main study. The target sample was three participants in line with the methods of the wider study where participants were selected from the pilot questionnaire phase based on their demographics and pilot questionnaire data.

The testing of the interview guide resulted in minor typographical changes and re-ordering of some of the elements, overall the guide was appropriate for use. This included three pilot interviews (two in person and one via video technology). Following analysis of the pilot interviews, an initial framework was developed this was the basis of the framework for the wider study and allowed initial themes to be identified.

The working framework based on the pilot results included four themes:

- The technology needs to work. This is made up of sub-themes of ''user satisfaction'' and ''technology, designs, and decisions''.
- Subject matter – Perspectives on AF and NOACs.
- Perspectives on the VP's purpose. This is related to the final theme and also has its own sub-themes of ''benefits to the user'', ''considerations for implementation and future designs'', and ''educational perspectives''.
- Audiences - pharmacist roles and sectors of practice.

5.5.2 Interview technique

As discussed in section 4.4.4, the study used semi-structured interviews. As part of this, the interview guide that was developed (section 5.5.1) was a guide rather than a schedule intended to be rigidly stuck to. According to DiCicco-Bloom and Crabtree (2006), semi-structured interviews are organised around a number of pre-set open questions with other topics and questions emerging from the dialogue. On the basis of this flexibility the participant to expressed themselves in their own words and the interview guide was adapted as interviews progressed to include new topic areas and discussion points. This allowed for the conversation to flow naturally and topics were introduced once previous ones had been exhausted. The interview guide included prompts should the interviewer be required to explore, clarify or rephrase a question (Kallio *et al.* 2016).

Interviews were conducted either face to face, in a location of the participant's choosing and thus of familiarity to them or by video technology or telephone. Telephone or video interviews were pre-arranged, and the interviewer called the interviewee at an allotted time. The interviewer introduced themselves and an initial small amount of general chat occurred. Following this, the interviewer discussed consent and the structure of the interview, before which the participant provided a second verbal consent (written consent was obtained prior to interview). The interviews were unlikely to bring up any uncomfortable or distressing topics, nonetheless, it was clear to participants that the interview could be stopped at any time. The interviewer then discussed their background briefly in terms of reflexivity (sections 4.5.4 and 10.6). before starting the interview.

All of the interviews were audio-recorded and transcribed verbatim. The interviewer documented any observations, interpretations or opinions that occurred during the interviews. These notes were included to guide analysis where they contributed to the coding process and helped to interpret participant data and document perspectives (Pope *et al.* 2000). The notes were also useful to refine interviewer technique as conducting interviews is a skill which needs to be reflected upon and refined to maintain and improve on (Byrne 2011).

5.5.3 Data analysis

Interview data were analysed using the framework approach to thematic analysis (Pope *et al.* 2000). This is process was designed for applied health research where the method identifies commonalities and differences in data on priority topics and focuses on relationships to arrive at descriptive and explanatory conclusions (Gale *et al.* 2013). It is well suited to this study's research aim and objectives that were exploratory in nature and focused on understanding perspectives. The framework method is not associated with any particular philosophical stance but it is flexible provided the aim of the research is to generate themes (Gale *et al.* 2013). As part of a thematic analysis interpretation needs to be conducted with a level of system and

reflection on the part of the researchers who need to become skilled in this (Gillham 2005). A degree of self-detachment is required to do this and researchers need an awareness of the pre-conceptions of the topic and of the participants before starting the research (Gillham 2005), this was built into reflexive practice. An advantage of the framework approach specifically, is that it was designed so that data are systematically analysed, consequently this allows readers to make their own judgements about the transferability of the findings to their own work when the study results are presented (Pope *et al.* 2000).

The framework method follows five stages (Ritchie and Spencer 1994, Pope *et al.* 2000). Initially, the transcripts were checked for accuracy and any errors amended by the lead researcher (CR). CR also went through a process of familiarisation with the raw data and transcripts to start constructing key ideas as the foundation for the themes. The data were then systematically reduced to codes using a set of stages to organise, categorise and analyse data (Pope *et al.* 2000 and Gale *et al.* 2013). The next stage mapped the codes to a framework which had been developed based on early familiarisation and coding. Following this, groups of codes were considered to identify themes; this was the lengthiest part of the analysis and was a cyclical process to consider and reflect on themes. Finally, the themes were interpreted and related to the aim and objectives of the study.

Qualitative data analysis started while data collection was ongoing so that continuing data collection could be moulded by interim analyses. This allowed for the constant refinement of questions, the pursuit of emerging unexpected themes and identification of deviant cases (Pope *et al.* 2000). In this study, a balance between inductive and deductive analysis was used to do this, this is a method that has been shown to be useful when the research question has some pre-defined areas to explore but allows the option to discover unexpected themes and it is well suited to the framework (Pope *et al.* 2000, Gale *et al.* 2013). This process started when pilot interviews were conducted, where the data were analysed alongside some pre-set ideas from the literature . This occurred together with inductive analysis of themes and ideas taken

directly from the data. Moving forward into the wider study, themes identified from the pilot study were used as a starting point for the wider analysis, these were not definite and as the analysis progressed new themes were added and older themes were transformed and thus the process was a balance between inductive and deductive analysis.

5.5.4 Data saturation

To increase the quality of the research, the research team considered what defined the point of data saturation (Fusch and Ness 2015). As already discussed (section 5.3.1), Guest et al. (2006) recognised the difficulty of defining data saturation stating that there were no practical guidelines to implementing the theory in practice (Guest *et al.* 2006, Hennink *et al.* 2017). In this study, a number of approaches were adopted to address this. Firstly, considering studies reporting VP use, data saturation does not appear to have been discussed, although this may be because the majority of methods were not qualitative. In one study on VP use in pharmacy 20 telephone interviews were undertaken and it is not clear whether saturation was reached (Thompson *et al.* 2017). Similarly, in another study that qualitatively gathered perspectives on VP use, data saturation was not discussed (Bearman 2003). Following this, key areas were identified which were the predominant topics to be saturated in the qualitative phase. These were based on the aim and objectives of the study and were adapted as the research progressed. The initial key areas to be saturated were:

- Technological usability of the application;
- Perspectives on the education and training, and CPD of pharmacists and pre-registration trainees particularly around audiences and users of the VP;
- Improvements to the VP application and other possible applications in the future;
- Perspectives on the design and overall purpose of the VP especially regarding feedback and use of the MCQ options.

In addition to the initial key areas, other emerging areas were also incorporated into the themes such as the broader ideas of implementation which emerged to be significant (chapter 9). In order to establish if the areas were saturated particular attention was taken to the coding process to consider the *thickness* and *richness* of the data and to the construct of themes by a number of internal reviews. Finally, considerations were taken regarding the nature of the participants undergoing an interview, as those with different demographics and pharmacy roles may have impacted the rate at which data saturation was reached.

An important element of this approach to data saturation is that it does not solely rely on 'coding saturation' but also embraces the idea of 'meaning saturation' as discussed by Hennink *et al.* (2017). Data saturation should not rely on simply identifying the range of thematic issues but also the richly textured understanding of the thematic issues (Hennink *et al.* 2017). This is evidenced by a small number of additional interviews being undertaken in order to better cement understanding of the themes once data saturation was reached (section 5.5.4). On the basis of this, the research team determined that all of the themes were present after 12-15 interviews however it was not until 19 interviews that the research team determined that data saturation of the key areas had occurred. In order to cement this status an additional three interviews were conducted. These acted as a way of considering if any further meanings were retrieved from additional interviews.

5.6 Implementation analysis

During the course of the interviews the large range of perspectives on implementation and use of the VP in pharmacy practice became apparent. This was not anticipated in the planning of the research but emerged to be significant. On the basis of the iterative nature of this and of pragmatism as a methodology, the methods of the study were adapted to include a supplementary analysis specifically targeting implementation (section 9.3). This was used in

addition to the framework approach to thematic analysis (section 5.5.3) with the intention of complementing the thematic analysis via specifically addressing implementation.

For the implementation analysis to take place the consolidated framework for implementation research (CFIR) was used (Damschroder *et al.* 2009). This framework was selected as it was developed as part of health service research and as stated by the authors it provides:

> *''a pragmatic structure for approaching complex, interacting, multi-level, and transient states of constructs in the real world by embracing, consolidating, and unifying key constructs from published implementation theories.''* (Damschroder *et al.* 2009)

This sits well with the pragmatic approach to the research study and that the chosen framework had to be adaptable to best consider the research aim and objectives. A number of options were considered to try to identify a framework that would sit well with the study design and purpose. This included the reviews by Meyers *et al.* (2012) and Moullin *et al.* (2015) and the framework by Greenhalgh *et al.* (2004). These were decided against for varied reasons including that they were not suitable for health research or for technology-based implementation. Choice of a framework was complicated due to the implementation analysis being an additional analysis and that the study was not designed around implementation research and so no framework would fit completely. Studies that referred to the implementation of VPs were consulted. Zary *et al.* (2006) and Guise, Chambers, Conradi, *et al.* (2012), discussed implementation of a VP but the authors do not appear to have used an implementation framework to structure this. As such, consideration of implementation, appears to be an original feature of this VP study.

The CIFR was chosen because the constructs relating to the intervention sat well with the VP application as did the applicability of the CFIR to both a health and technology-based application, particularly areas concerning wider aspects for implementation on an

organisational level. The practicalities of using the CFIR to consider implementation of the VP will be discussed alongside the results of this analysis in section 9.3.

5.7 Summary

This chapter has summarised the methods used to conduct this research, including the decisions made during the choosing of the methods and the associated instrument development. Additionally, there was discussion around why the methods were appropriate for use.

6 Questionnaire results

6.1 Introduction

In the previous chapters the context was laid for the planning and conduct of this research. The results of the first phase of the study are now presented. The questionnaire results include both descriptive and inferential analyses and an exploration of the demographics of the respondents. The chapter concludes with a brief discussion of the relevance of the findings, which includes highlighting results that were significant for the second phase of the study.

6.1.1 Aim of the questionnaire phase

Considering the aim and objectives of the wider study, the questionnaire phase specifically aimed to contribute to investigating the learner reported value and acceptance of the VP primarily through exploring the ability and usefulness of the VP to teach NOAC counselling and to explore satisfaction with the VP and how this effects usability. Also, to gather preliminary information on possible improvements to the VP.

6.2 Participant demographics

The questionnaire went live in November 2018 and participation continued until August 2019. The study involved 14 sites, nine secondary care sites and five geographical regions for recruiting community pharmacists. Across the sites, 94 respondents took part in the questionnaire phase of the study. A number of potential respondents (n=32) initially consented to take part in the questionnaire phase of the study but then did not return a completed questionnaire despite being sent a number of reminders via email. The reasons for this are unclear.

Variable	Whole sample	Pre-registration trainees	Qualified pharmacists	Community	Hospital
Gender					
Male	24 (25.5%)	1 (4.3%)	23 (32.4%)	8 (30.8%)	13 (21.3%)
Female	70 (74.5%)	22 (95.7%)	48 (67.6%)	18 (69.2%)	48 (78.7%)
Age group					
20-29 years	48 (51.1%)	22	26	11	33
30-39 years	29 (30.9%)	0	29	8	18
40-49 years	13 (13.8%)	1	12	4	9
50-59 years	4 (4.3%)	0	4	3	1
Older than 60 years	0 (0%)	0	0	0	0
Qualification status					
Pre-registration trainee	23 (24.5%)			3	18
Qualified pharmacist	71 (75.5%)			23	43
Length of time qualified					
Less than 5 years	23 (24.5%)		23	8	13
5-10 years	29 (30.9%)		29	6	20
11-20 years	12 (12.8%)		12	4	8
More than 20 years	7 (7.4%)		7	5	2
Sector of practice					
Community	26 (27.7%)	3	23		
Hospital	61 (64.8%)	18	43		
Other	7 (7.4%)	2	5		

Table 6.1 Respondent demographics

Of the 94 respondents, 61 were from the hospital sector, 26 were from the community sector, with seven reporting other sectors of practice due to split roles (Table ***6.1***). The respondents were from 14 sites which were well spread across England and a mix of secondary care NHS sites and regional CRNs for recruiting community pharmacists; the largest site had 14 respondents (n=14.9%).

Concerning gender, there was a split of 25.5% (n=24) male and 74.5% (n=70) female across the respondents. Concerning age groups, 20-29 years was the most common age group (51.1%, n=48) and older than 60 years was the smallest group (0.0%, n=0) (Figure ***6.1***). Similarly concerning the length of time since qualification, 5-10 years was the most common length of time since qualification (30.9%, n=29) and more than 20 years the least (7.4%, 7) (Figure ***6.2***). There was a spread of 71 respondents (75.5%) vs 23 respondents (24.5%) between qualified pharmacists and pre-registration trainees.

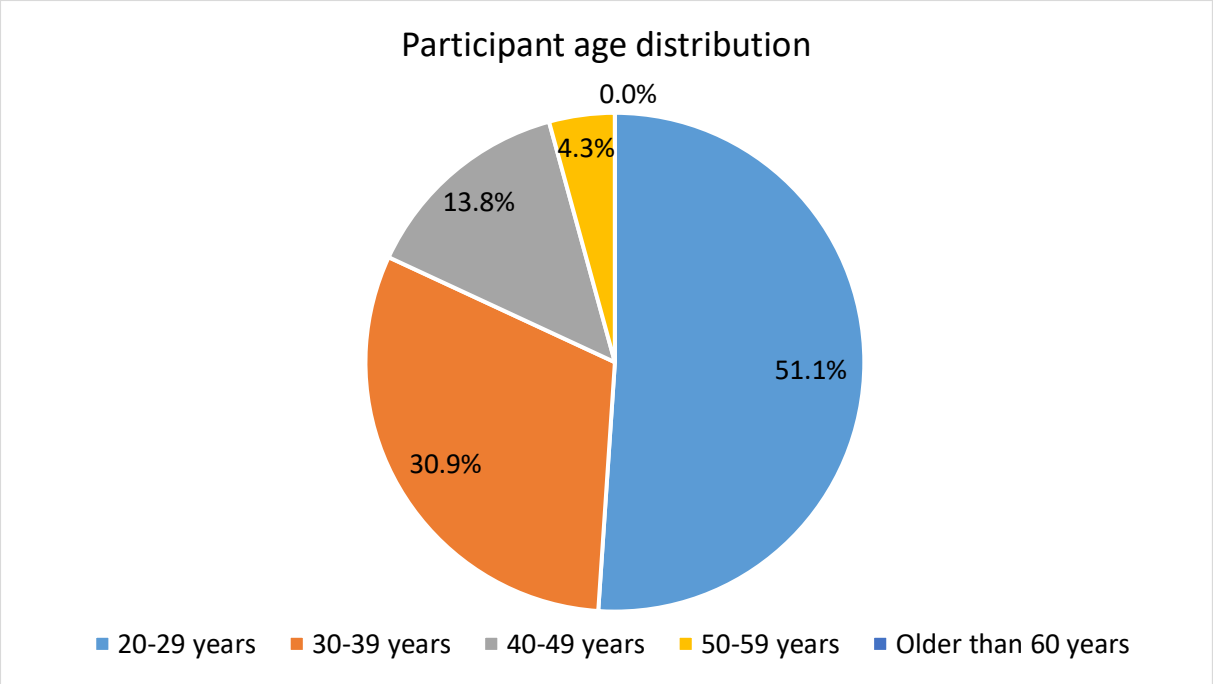

Figure 6.1 Respondent ages

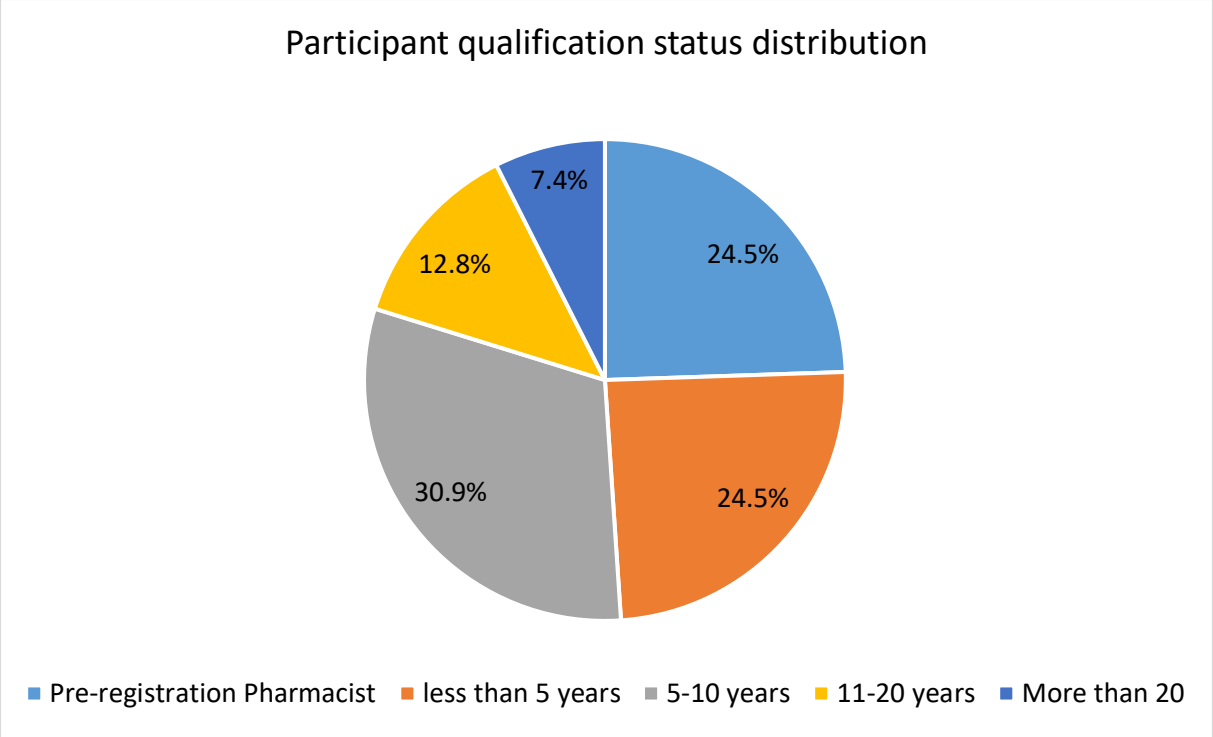

Figure 6.2 Respondent qualification status

6.3 Initial thoughts and perspectives

One of the first questions posed concerned previous experiences of using VPs, where the vast majority of respondents reported no previous experience (n=71, 75.6%). A number of respondents mentioned VP experience either through other courses such as independent prescribing or MUR training, or through other simulation technologies including both high and low fidelity applications, a named example being *SimMan* (Figure ***6.3***).

Respondents were further asked about previous training concerning NOAC counselling. The responses to this question have been grouped into topics and the frequency that each topic was mentioned was calculated (

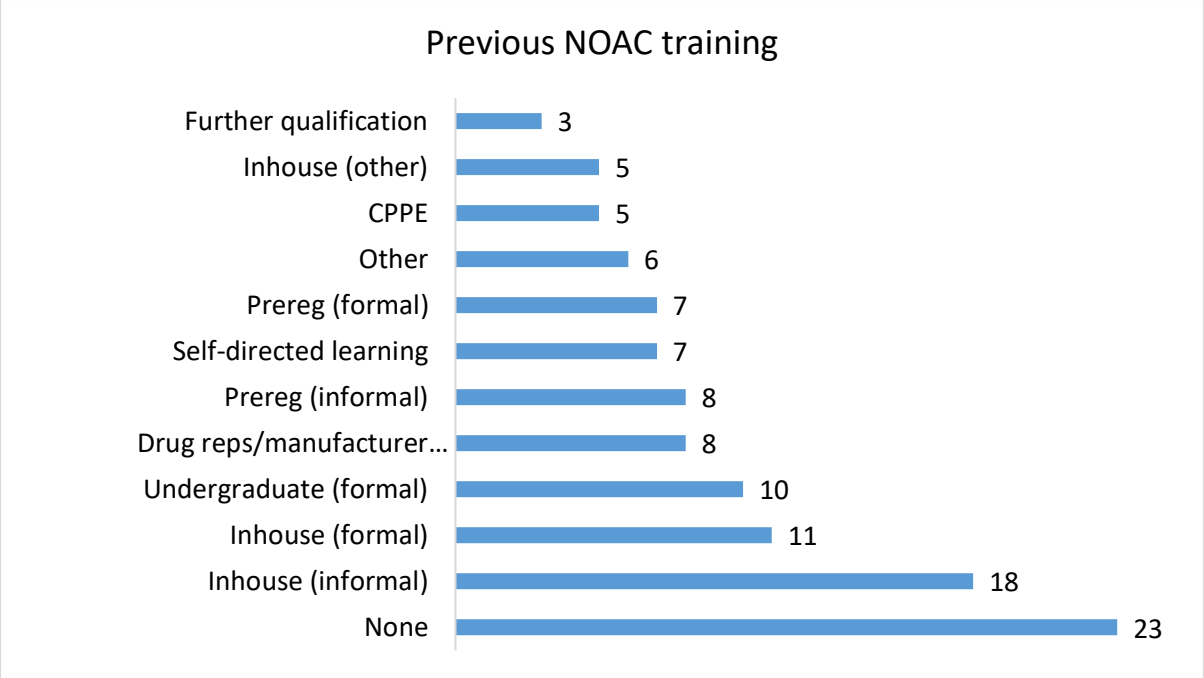

Figure *6.4*). The most common response to this question was no previous training or education (n=23, 20.7%); this was more common in those from the community sector. A number of respondents did report forms of 'in-house' training, which appeared to be more common in those from the hospital sector. Within the 'in-house' group the form of the education and training varied and included both formal learning (n=11) and informal or observational learning (n=18). Formal learning included other qualifications including part of a clinical diploma (n=1) and the independent prescribing qualification (n=1), and informal or observational learning including peer discussions and peer-to-peer feedback as is illustrated by the quote below. A small number of respondents reported undertaking self-directed learning (n=7, 6.3%).

> *''I carried out a role play counselling with my supervisor and peer using a trust guideline/checklist. I then counselled a patient with supervision three more times with supervision before being allowed to counsel patients alone''* [P64]

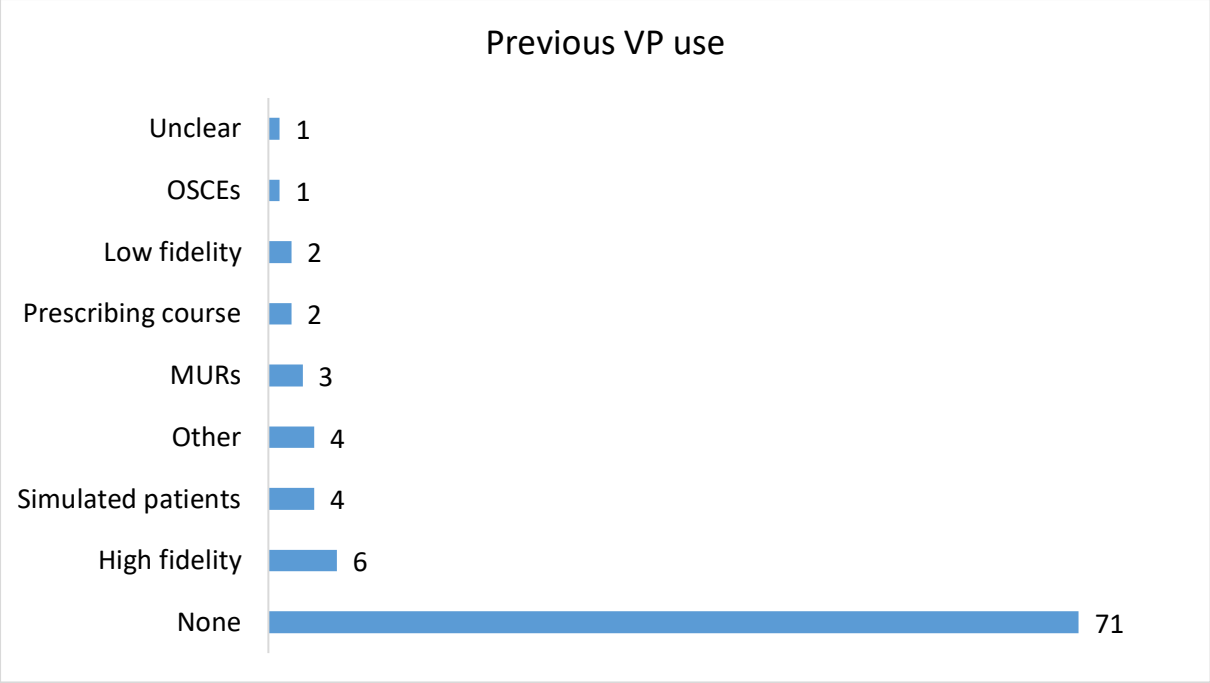

Figure 6.3 Content analysis of previous VP use

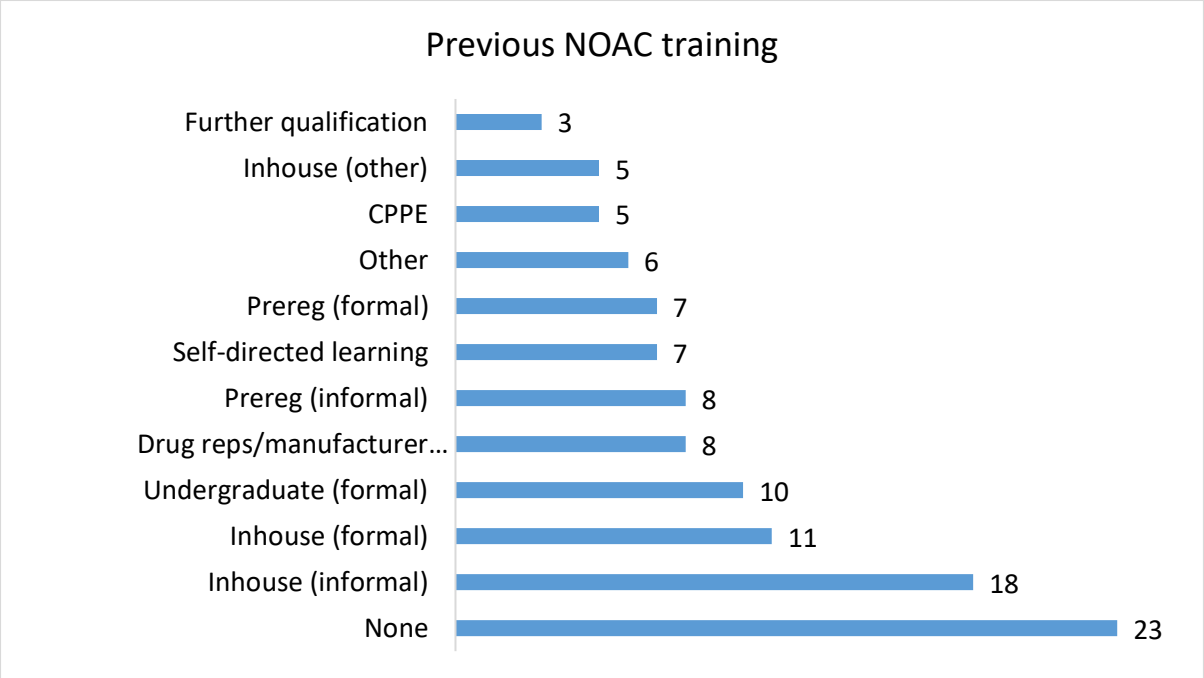

Figure 6.4 Content analysis of previous NOAC education and training

Prior to trialling the VP, respondents were asked a series of Likert questions regarding their current practice and the likely interest in further NOAC education and training. They were asked how often they currently conduct NOAC counselling for AF using a rating scale of ''never'' to ''very frequently''

(Figure ***6.5***); 67.0% of responses were for ''once in a while'' or ''occasionally''. The median score was ''occasionally'' (interquartile range IQR=1). Respondents were then asked how confident they were about conducting NOAC counselling using a scale of ''not at all'' to ''extremely'' and 72.4% of responses were for ''moderately'' and ''quite'' (median ''quite'', IQR=1) (Figure ***6.6***).

The respondents were also asked about their interest in learning more about NOACs and AF (from ''not at all'' to ''extremely''). Responses were more consistent for this question with the majority of answers (90.5%) corresponding to ''quite'' and ''extremely'' (median ''quite'', IQR=1). The same was true for the question about the potential usefulness of such training, where the median was ''extremely'' and 94.7% of responses were for ''quite'' and ''extremely'' (IQR=1) (Figure ***6.7***).

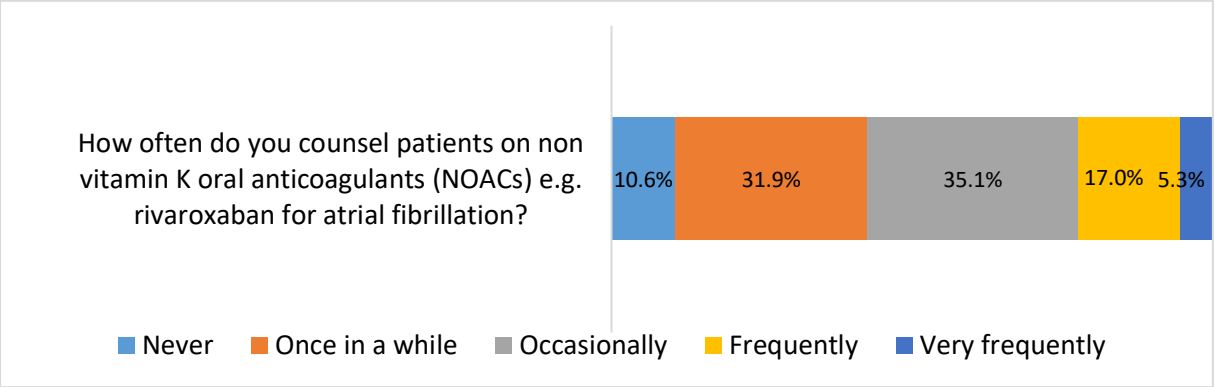

Figure 6.5 Responses to the Likert question concerning the frequency of NOAC counselling

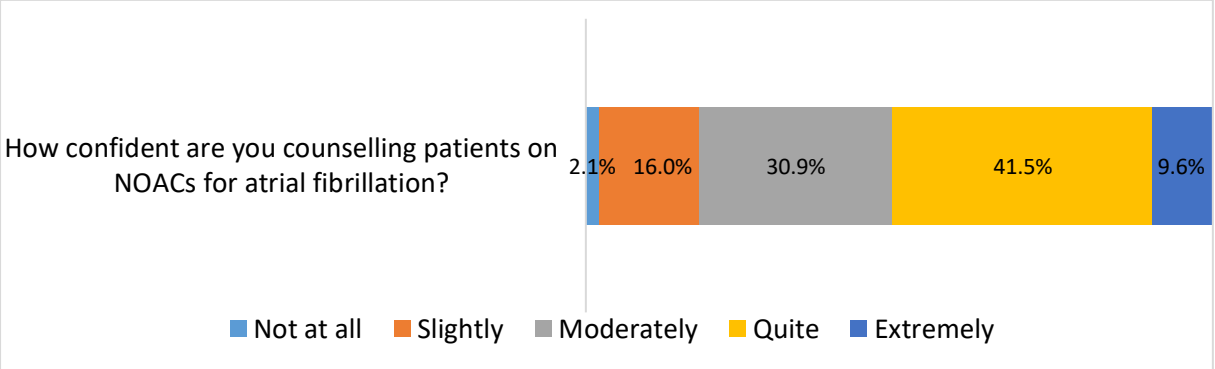

Figure 6.6 Responses to the Likert question concerning confidence in NOAC counselling

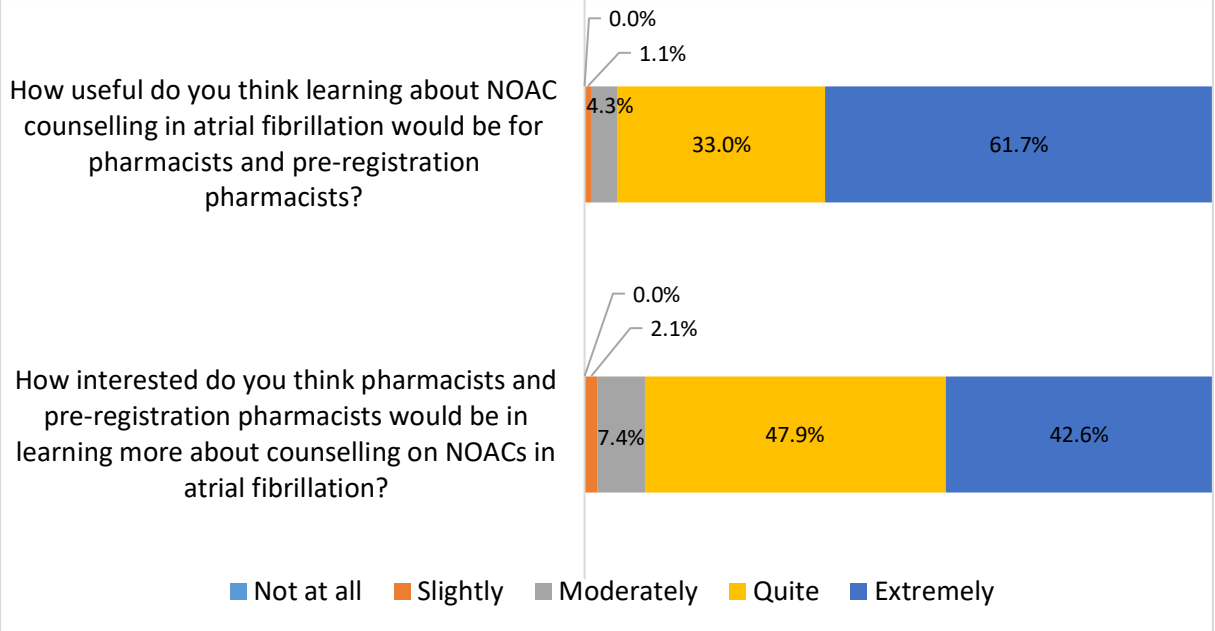

Figure 6.7 Responses to two Likert questions concerning the usefulness of further learning on NOACs and the interest in further learning on NOACs

6.4 Pre- and post-VP ability

Respondents were asked to rate their perceived ability to counsel a patient on given sub-areas of NOAC counselling using a Likert scale of ''poor'' to ''excellent''. There were 11 items, and these were asked before and after respondent use of the VP. The questions did not test knowledge but reported a participant's perception of ability. As discussed in section 5.4.3, this Likert data was treated as interval data and underwent a t-test calculation, therefore averages were calculated using means; medians were also calculated to support use of the mean as discussed in section 5.4.3.

This analysis showed that on average, respondents' scores increased after VP use, with an average increase of 10.2% (-30.3%-39.6%). Similarly, the median percentage change pre- to post-VP use was 8.2% (IQR=14.3%). Table ***6.2*** shows the similarity of the means and medians. Of the 94 respondents, 71 (75.5%) demonstrated an increase in self-reported ability, 17 (18.1%) had no change and 6 (6.4%) had a decrease. Reasons for decreases were not entirely clear but are discussed in section 6.10. The significance of the average change in scores pre- to post-VP was measured using a paired t-test determined via SPSS software (Table ***6.2***). This demonstrated that the average change pre- to post-

VP use was significant (P<0.001). Further to this, the data were examined prior to the test to establish if the distribution was normal and thus that a t-test was suitable for use. As discussed in section 5.4.3, a Kolmogorov-Smirnov test was used to show that the change in participant scores pre- to post-VP were normally distributed (P<0.001).

	Mean	95% CI	Standard deviation	Sig. (2-tailed)	Median	IQR
Pre-test	42.27	40.8-43.7	7.13	-	43	37-47
Post-test	47.16	46.0-48.3	5.59	-	47	47-52
Difference pre- to post-VP	4.89	3.75-6.03	5.66	0.000	4	6

Table 6.2 Analysis of the significance of the average change in pre- to post-VP self-reported ability using a t-test

6.5 Satisfaction with the VP

6.5.1 Technology

After using the VP, respondents were asked a series of Likert questions concerning their satisfaction when using the VP and their view of the VP's technical usability. Respondents also scored the VP's usefulness, their enjoyment using it, the difficulty in using it, their comfort using the technology, likeliness to use it again and if they would recommend it to others. Each question used a Likert scale of ''not at all'' to ''extremely'' (Figure ***6.8***)

For the questions regarding enjoyment, comfort, usefulness, likeliness to use the VP again and likeliness to recommend it to a colleague the median scores were ''quite'' (IQR=1, except for questions on using the VP again or recommending it where IQR=2). Despite this, there were some differences in the spread of results across the Likert. Enjoyment using the VP had 73.4% of responses for ''moderately'' or ''quite'', likeliness to use the VP again had 53.1% of responses for ''moderately'' or ''quite'', and recommend to a colleague had 59.6% of responses for ''moderately'' or ''quite''. The

question regarding the usefulness of the VP was more positive as 80.9% of responses were for Likert scores of ‘’quite’’ and ‘’extremely’’.

For the question regarding difficulty using the VP the median score was ‘’not at all’’ (IQR=1), suggesting that the majority (86.2% for ‘’not at all’’ and ‘’slightly’’) did not find the technology difficult to use. The usability questions indicate that respondents, on average, found the VP usable and would it again and/or recommend it to others. A small group of individuals appeared to not enjoy using the VP and were more negative regarding its usability.

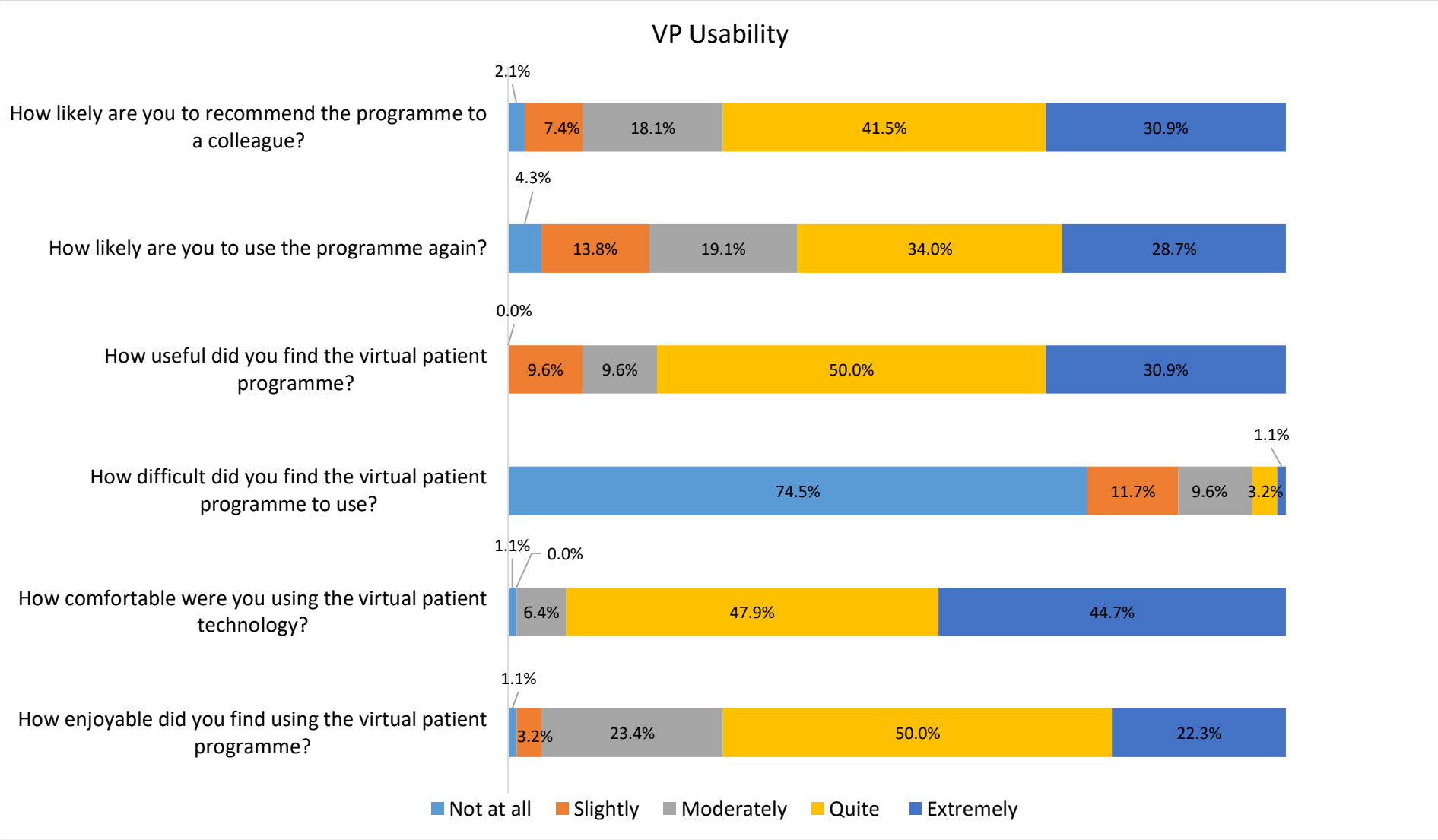

Figure 6.8 VP usability assessed via six questions using a scale of not at all to extremely

6.5.2 Scenario content

There was a further group of questions that concerned the VP scenario and design. This included questions concerning feedback, VP questioning style and realism and were measured on a scale of ''strongly disagree'' to ''strongly agree'' (Figure ***6.9***). All of the questions in the series had a median score of ''agree'' indicating that respondents on average were positive towards the VP. However, despite having the same median, the spread of data across the Likert did vary.

The MCQ options question was the question with the biggest range in responses, percentage score for responses of ''agree'' or ''strongly agree'' was 57.4% (IQR=1). Similar results were observed for the scenario playing out much like it might in practice (68.1%, IQR=1) and the likability of the feedback (73.4%, IQR=2). Conversely, the question asking if the VP had fulfilled its aim had 82.9% ''agree'' or ''strongly agree'' responses (IQR=0). The areas which had a greater spread across the Likert and a lower percentage of scores relating to ''agree'' and ''strongly agree'', namely the MCQs options, the scenario playing out like it might in practice and the likability of feedback, were identified as areas to explore in the qualitative interviews (section 6.11.2).

Further questions asked whether respondents thought that the VP had changed their knowledge about NOAC counselling and their confidence, and whether this would result in a change in their practice. These questions also used Likert scales of ''strongly disagree'' to ''strongly agree'' (Figure ***6.10***). The spread of the responses for the three questions were similar and the median scores were identical (median ''quite'', IQR=0 for knowledge, IQR=1 for confidence and change of practice). The question regarding confidence had the lowest proportion of ''agree'' and ''strongly agree'' responses (70.2%) although this was close to the scores of the other two questions (72.3% knowledge, 75.5% change of practice). This suggests that users thought that the VP can change knowledge and confidence and could lead to changes in their practice. However, it is difficult to establish from this data whether there was a greater perceived effect of one of these outcomes over the other. Where there were responses that disagreed with this, they tended to be across all three questions when

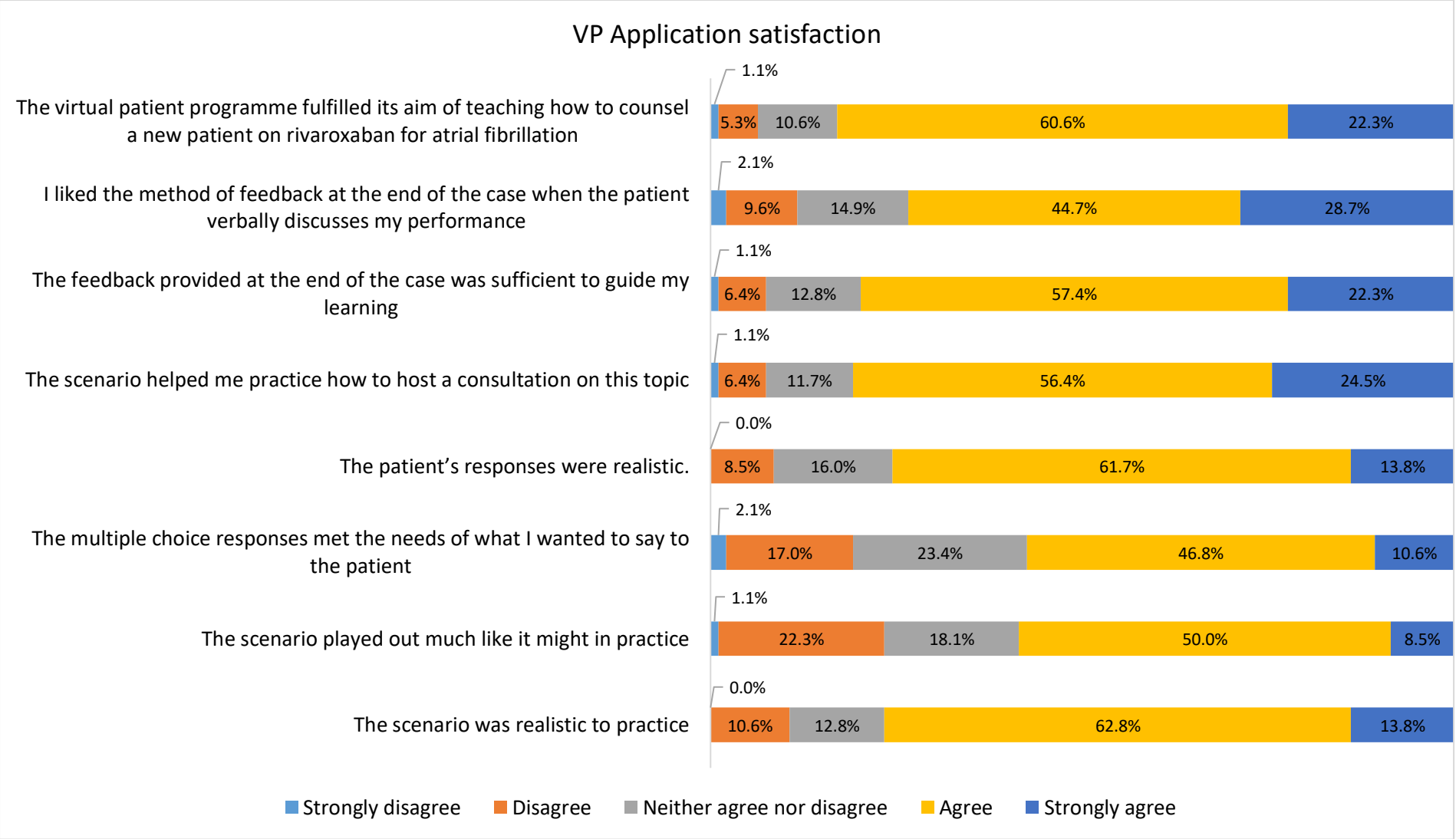

Figure 6.9 VP application satisfaction measured across three Likert questions

individuals did not like the VP. Some of the reasons for this are addressed by the free text questions within the questionnaire (section 0) and the issue was also explored in phase two of the study.

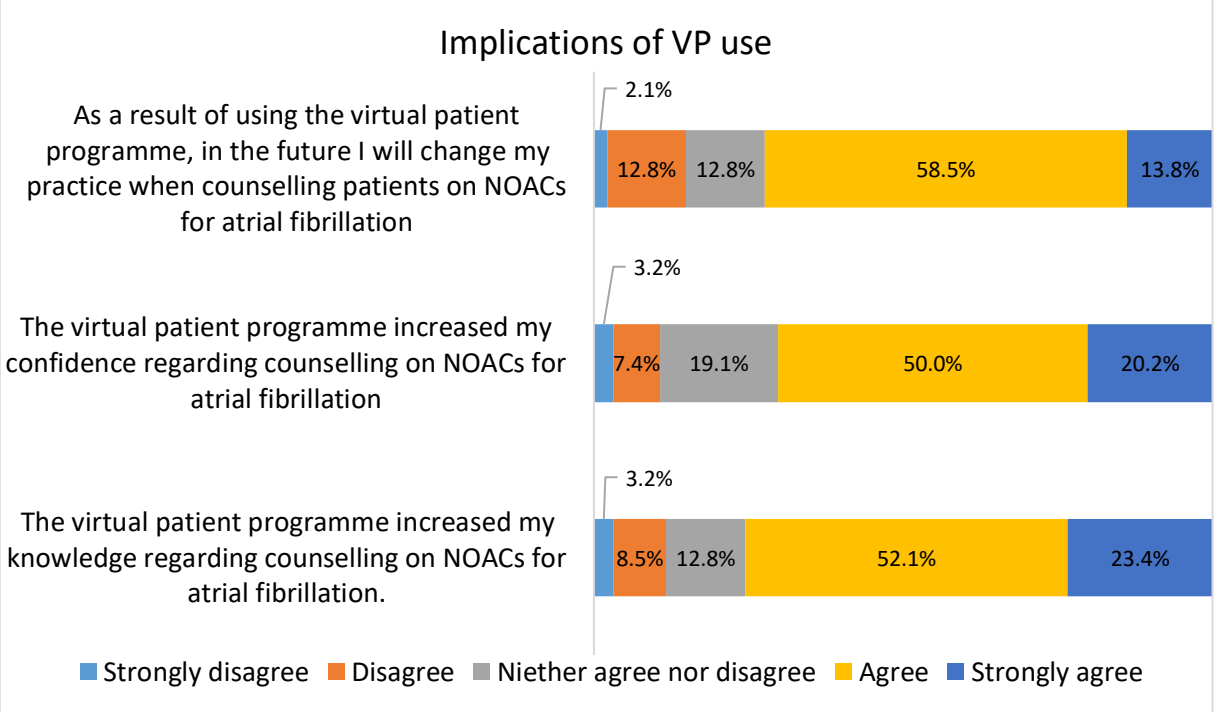

Figure 6.10 Implications of VP use across three Likert questions

6.6 The purpose of the VP

After using the VP, the respondents ranked five outcomes to indicate the way in which they perceived that it had impacted on their learning and development (1 biggest impact to 5 smallest impact) (Figure ***6.11***). 'Change of knowledge' and 'change of confidence' received scores corresponding to the largest impact (average ranking 3.3 and 3.6 respectively) followed by a 'development in generic consultation skills' and 'contribution of CPD' (3.1 and 3.0 respectively). Finally, the outcome with the least impact concerned a change of knowledge around NOACs more generally in other indications (2.0).

As the data for this question was ordinal, the significance of this result was assessed via a Friedman Test (Table ***6.3***), which is a non-parametric test for comparing variables, as discussed

in section 5.4.3. The Friedman test indicated that the VP outcomes posed to the respondents were ranked statistically differently, $\chi^2(4) = 52.175$, ($p<0.000$). It is unclear exactly where this significance lies due to the nature of the statistical test. It is not possible to differentiate entirely between the options but, this question, along with the Likert questions contributed to an interpretation of what respondents reported to be the VP's overall purpose. On an individual level, the majority of respondents ranked the outcomes in roughly the same order as the average rankings, but some individuals appeared to perceive the purpose of the VP as completely different. For example, some individual respondents reported a 'contribution to CPD' or 'contribution to generic consultation skills' as having the greatest impact with 'knowledge and confidence changes' ranked lower down. 'Contribution to CPD' and 'development of generic consultation skills' both received a similar number of rankings for both the largest and smallest impacts, this further highlighted that different users appeared to perceive the purpose of the VP differently to each other.

From the free text questions later in the questionnaire (section 0), some further insight into the responses of this question were found. It appeared that some of the design elements such as the section at the start of the application which focuses on checking the identity of the patient, could be affecting respondents' perceptions on the purpose of the VP:

> *''Is the intended purpose to spend time making sure colleagues are checking the address on the script, or that they are offering to take the patient to the counselling room? If the session is on counselling for rivaroxaban, make it about counselling rivaroxaban.''* [P25]

Subsequently, respondent's perspectives on the purpose of the VP were explored further in phase two of the study.

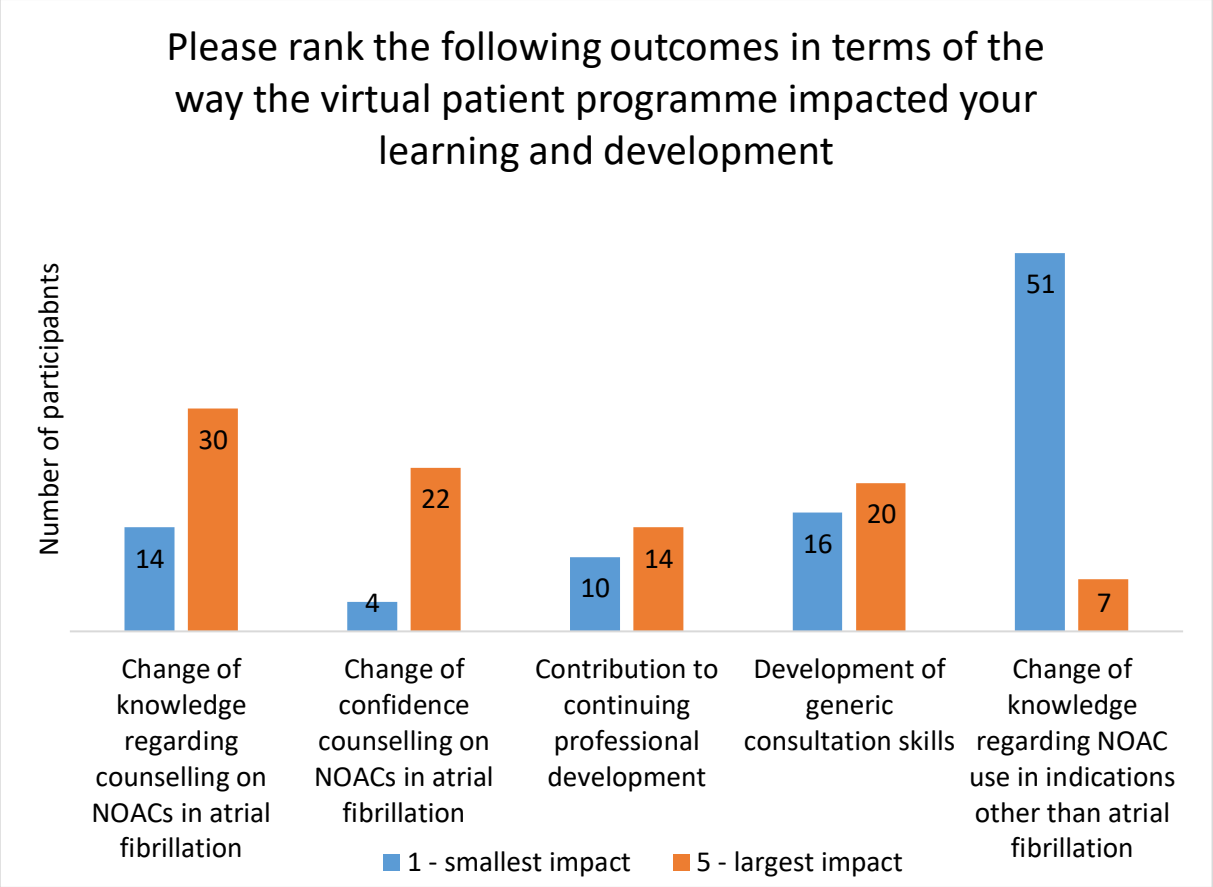

Figure 6.11 The frequency of times that possible learning outcomes of the VP were ranked as having the smallest and largest impact on a participant's learning and development

Friedman Test	
N	94
Chi-Square	52.175
Asymp. Sig.	0.000

Table 6.3 Results of a Freidman test for analysing the results of a ranking question concerning the purposes of the VP

6.7 Additional thoughts and perspectives from free text questions

At the end of the questionnaire, respondents were asked short answer questions to gather free text information on their perspectives and feelings towards the VP. This included what the respondents thought were the best and worst things about the VP, these responses were analysed for their content and frequency. A summary is shown in Figure ***6.12*** and Figure ***6.13***.

The respondents gave positive feedback on the interactivity (14.5%) and realism (18.8%) of the application and also on the case feedback (15.4%). Other points included the opportunity to practice the NOAC consultation, the sophisticated animations and technology, and the importance of patient interaction.

In relation to the three most common topics, respondents appeared to have appreciated the feedback and found it useful, for example:

> *''The feedback received at the end; it was not in a generic form instead it was based on my responses''* [P30]

Respondents also enjoyed the realism of the case, particularly the patient responses, as the following comment shows:

> *''Overall quite realistic patient responses''* [P11]

Additionally, respondents were positive towards the realism in that the VP responded to the choices of the individual user:

> *''It was realistic, and the scenario changed based on the questions you asked''* [P6]

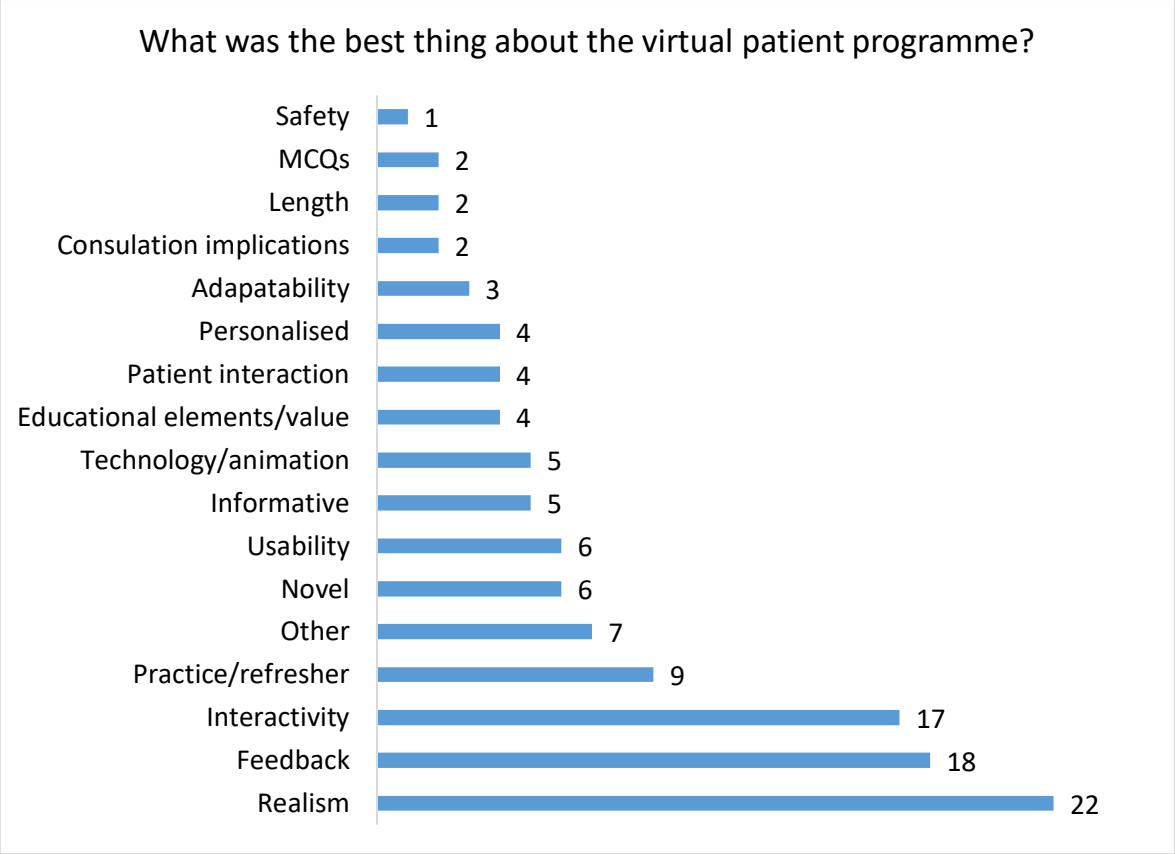

Figure 6.12 Content analysis of the question "What was the best thing about the virtual patient programme?"

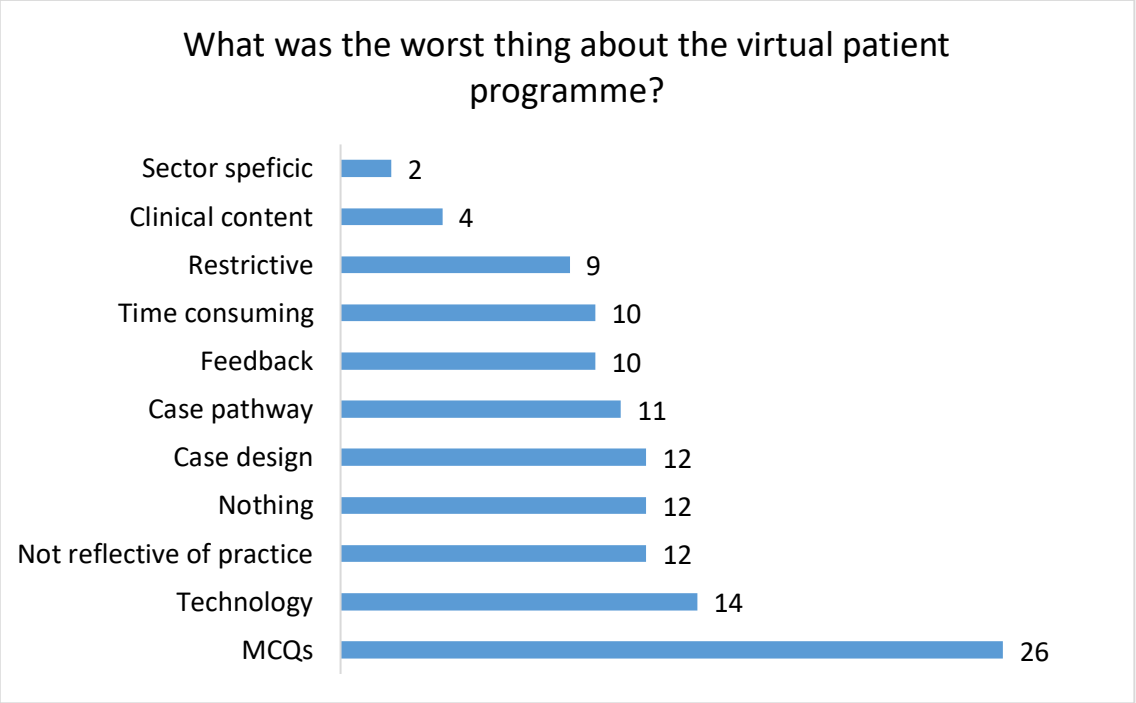

Figure 6.13 Content analysis of the question "What was the worst thing about the virtual patient programme?"

The interactive nature was also appreciated and commented on multiple times:

> *''Interactive nature. You can have a play around, and not be scared to cause any harm to a 'real' patient''* [P35]

Conversely, the most commonly cited negative comments were the MCQ options (which were the questions posed to the user through the case) (21.0%), the technology (11.3%), that the extent to which the case is reflective of practice is limited, (9.7%) and the perception of a limited case design (9.7%). However, a proportion of respondents said there was ''nothing'' bad to comment on the application (n=12). These areas will be discussed in more detail below.

The majority of comments concerning the MCQ options were around the perception that the question options did not include everything that an individual might say in a consultation or incorporate what an individual's consultation structure might be.

> *''The multiple-choice answers were generic and not always the options I would choose when counselling a patient''* [P4]

A number of respondents also commented on the restrictive nature of the MCQs and that this consequently limits the ability of the VP to be reflective of practice. Participant 11 discussed ''pigeonholed'' responses which links to the idea of an underlying algorithm.

> *''Every answer or action is pigeonholed to three or more answers and depending on your selection the consultation can come to an abrupt ending. This is not a true reflection of real-life practice''* [P11]

Realism to practice was also reflected in a group of comments on the case length. Only a minority of users discussed this; where this was discussed the consensus was that the application was too long. It is unclear as to what the whole sample thought about the case length.

> *''A bit longer that I would have liked''* [P64]

Technology was another key topic and some respondents reported that the system was 'slow' or that they had technical issues:

> *''Very slow at responding. Quite frustrating waiting for a response. Instructions on how to use it would have been helpful (i.e. what each button does etc.)''* [P56]

Respondents also made recommendations for how they thought the VP could be developed (Figure ***6.14***). The most common responses, some of which are discussed below, were largely linked to the areas previously identified as the 'worst' areas of the VP design.

This included comments around changes to the case pathway and design, particularly the MCQ options and the underlying questioning methods used in the VP application. This was one area which was identified as a 'worst' element of the VP but suggestions for improving this were made. Respondent 25 discussed that the MCQs were difficult to distinguish between as there was overlap between them. One example of this is evident in Figure ***1.4***, where the application gives the options of ''yes please'', ''hello'', and ''hi Henry how are you today''.

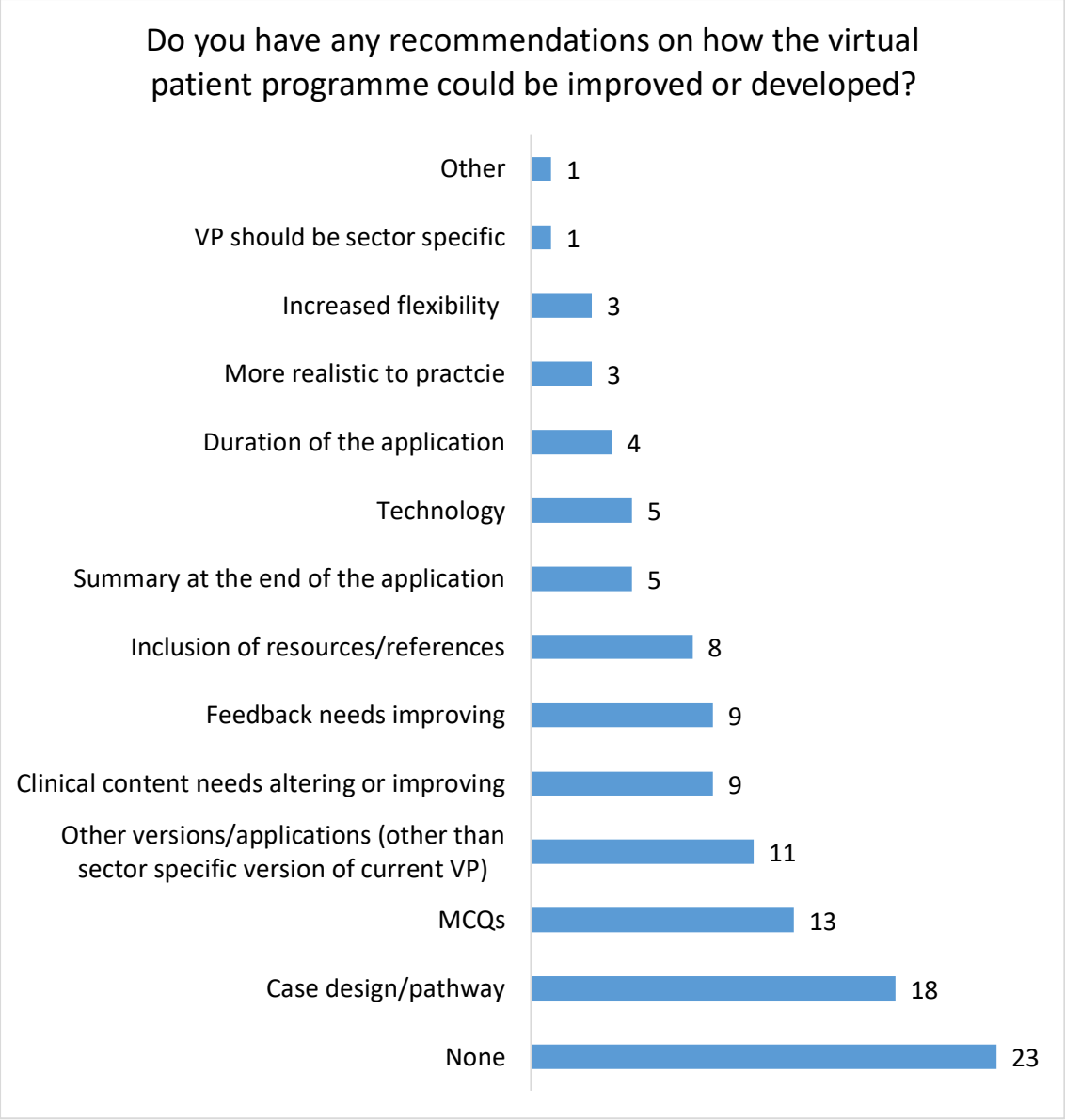

Figure 6.14 Content analysis of the question ''Do you have any recommendations on how the virtual patient programme could be improved or developed?''

''Adjust the options so that they are clearly different, some overlap or are so similar as to be unnecessary, also there are several choices that really do not need to be choices.'' [P25]

Some respondents did suggest further applications for the technology:

> *''I'd like to see it used for more conditions/diseases requiring long term medications and encompass monitoring advice''* [P17]

Suggestions for a further summary at the end of the application were made by five respondents and there were a number of suggestions around further resources and references (n=8). For example:

> *''It would be good to have a transcript of an ideal patient counselling at the end of the programme''* [P10]

> *''Useful reference at the end would be beneficial for further reading''* [P21]

A few suggestions were made around clinical content and improving this element of the case, an example being:

> *''more clinical depth, I get asked things like 'what is atrial fibrillation' 'is it dangerous' 'why do I have to take this medication when my stroke risk is only 6% that seems low'''* [P2]

Equally, one participant suggested that the content of the application was currently not accurate considering what they were expecting of a patient with Henry's past medical history. They did not elaborate on what exactly they meant by the following quote:

> *''Update the medical history to correctly reflect a real patient with these clinical conditions''* [P37]

Finally, respondents were asked about the potential impact of the use of the VP for patient care. Responses included benefits for pharmacist's counselling skills, both, through knowledge acquisition and the opportunity to practice.

> *''the virtual patient programme could help improve pharmacist patient counselling skills thus improving patient experience. It will also enable pharmacists to practice counselling patients enabling them to feel more confident in counselling patients and be more familiar with the process''* [P4]

The consequences of this learning for patient care was also related to patient safety and compliance:

> *''If all new medicines especially high-risk medicines like DOACs [direct oral anticoagulants] and VKAs [vitamin K antagonists] were explained in this manner it would have a hugely positive effect on patient adherence and safety''* [P11]

A number of respondents also commented on the usefulness of practical experience for conducting this type of counselling.

> *''Could play a significant role in improving counselling skills and improve skills for a particular subject without practicing on real patients. Improve confidence to talk to patients on a subject''* [P40]

6.8 Analysis of results by sector of practice

The study used respondents from the two main pharmacy sectors: hospital and community. A further analysis was undertaken which compared the results between the respondents who reported as working in one of the two sectors (Appendix VII.). Only those respondents who solely identified hospital or community as their sector of practice were included in this to avoid contamination by those working across multiple sectors. There were 26 respondents from the community sector and 61 from the hospital sector.

For the majority of questions using Likert scales, the median scores were identical for community and hospital respondents and the spread of the data were similar (appendix VII.). A small difference was found between the two sector groups regarding previous experiences of NOAC training. More hospital pharmacists appeared to have received NOAC education and training and this was in line with the confidence scores where on average hospital were ''quite'' confident as opposed to community pharmacists who were ''moderately'' confident.

Due to the difference in the size of the groups, no analysis was undertaken to consider any differences in the changes in self-reported ability between the two groups of respondents; the significance of the different group sizes is discussed in section 6.10. The analysis did not attempt to make any inferences between the groups but aimed to determine whether there were any apparent differences between the groups that could affect perceptions on the VP.

6.9 Analysis of results by qualification status

The final part of the questionnaire analysis was similar to that discussed in section 6.8, but involved comparing the data of those identified as qualified pharmacists and those identified as pre-registration trainees (Appendix VIII.). There were 23 pre-registration trainee respondents to 71 qualified pharmacists and as for the previous section the significance of the differences in the group sizes is discussed in section 6.10.

For the majority of questions using Likert scales, the median scores for both groups were identical. This is the case for all of the questions except the question concerning the comfort using the VP where qualified pharmacists scored it ''quite'' but pre-registration trainees were more positive and their median score was ''extremely'' (Appendix VIII.). The spread of data across the Likerts were also similar between the two qualification groups. One question where there was a difference, although small, between the groups regarded confidence in NOAC counselling where the median score was ''quite'' for qualified pharmacists and ''moderately'' for pre-registration trainees.

As in section 6.8 there was no analysis undertaken on any difference in the average change in self-reported ability. The differences that have been highlighted in this section are discussed in section 6.10.

6.10 Discussion

This section of the chapter discusses the results of the questionnaire in the context of the study's aim and objectives and the relevant literature. It also highlights the issues that were identified to be explored in the second phase of the study.

The majority of respondents appeared to find the VP usable, with few technical limitations. This was supported by the results for questions about the difficulty of using the application and comfort using the technology where a significant amount of the responses were positive. In line with a previous research recommendation to evaluate VPs with more sophisticated graphics and animations the VP makes use of modern animated technology (Jabbur-Lopes *et al.* 2012). This was something that respondents commented on as a positive feature and appeared to favour, which is particularly relevant as limitations in technology can detract from user experience and even affect outcomes (Douglass *et al.* 2013), as was a finding of the systematic review (section 3.5).

From the questions using Likert scales that had mixed results, some individual design elements of the VP were identified as not being well liked, this included the MCQ design and feedback design. The reasons for this were not entirely clear and so the topic was identified as needing further explanation in phase two of the study. There were mixed results concerning enjoyment using the VP and it was not clear why some respondents did not find using the VP enjoyable. This was another issue that was identified for further explanation in phase two. The realism of the patient's responses was well-liked, and this appeared to contribute to the likability of the VP. This finding is in line with other quantitative VP evaluations and reviews where VPs have been recognised to have high levels of user satisfaction (Battaglia *et al.* 2012, Jabbur-Lopes *et al.* 2012, Douglass *et al.* 2013, Bindoff *et al.* 2014, Smith *et al.* 2014, Zlotos *et al.* 2016).

A reasonable number of respondents would use the VP again or would recommend it to a colleague. No respondents had negative perspectives on the overall concept of the VP, but some suggested more clarity and instruction on using the application. Previous VP studies have found that familiarity with the technology can increase a user's acceptance of it (Taglieri *et al.* 2017) and technical glitches can negatively impact user performance (Douglass *et al.* 2013). In this study, although most respondents reported that the VP was not difficult to use, some did report that they did not like the restrictive or ''pigeonholed'' design of the application. This could have contributed to some of the mixed results concerning usability and acceptance.

The average increase in self-reported counselling ability pre- to post-VP suggests that there was a benefit to using the VP. For some individual respondents, there was no average change or a decrease in self-reported ability. For these users, the majority were still positive about using the VP and appeared to suggest that they still found some value in it although this could be in a different way to those users who reported an improvement in their ability. This could include learning around more general consultation skills, this type of learning became more apparent in the interviews (section 8.2.2). This is similar to the work by Taglieri *et al.* where

the measured improvement in student performance was not in line with that which was perceived by the respondents (section 3.4.3). The respondents did not find the particular VP useful for improving performance but, a change in performance was measured (Taglieri *et al.* 2017).

Negative changes in self-reported ability are more difficult to explain. One possible explanation is that the VP helped users to identify areas where they needed improvement hence their ability post-VP was scored lower than pre-VP as their ability was not as good as they had initially perceived (pre-VP). This concept was commented on in the work of Botezatu *et al.* (2010) who identified that VPs in medical students had a regulatory effect and helped to plan learning. Similarly in the study by Forsberg *et al.* (2016), nursing students reported feeling uncertain as the use of the VP had exposed knowledge gaps.

When respondents were asked if the VP positively changed knowledge, confidence and would result in a change of practice, there were mixed responses. The most commonly rated Likert scores suggested that the VP did have these effects. However, it is not clear is whether the VP has a greater effect on either knowledge or confidence. There is some evidence that VPs can help to develop knowledge such as the study by Zlotos *et al.* (2016), but less is known about the impact on users' practice and confidence. Equally, as already discussed in section 3.5, knowledge and ability outcomes can be difficult to measure which contributes to uncertainty about the value of the VP. Despite this, the findings of this phase of the study further demonstrate some of the already recognised advantages to VP use such as design potential, mobility, and accessibility, all with low levels of risk (Stevens *et al.* 2006, Douglass *et al.* 2013).

The questionnaire data provided information on previous NOAC education and training and although there was a range of previous NOAC training experiences, the extent to which it appears to be underprovided was striking. Numerous respondents reported having had no education or training, or that they had only had brief informal 'inhouse' training on NOACs.

This appeared to vary, particularly by sector of practice and role but, pre-registration trainees and those working in the hospital sector seemed more likely to have received training. This difference in training provision is recognised in the work by Power *et al.* (2008), who found that community pharmacists have less time available for CPD compared to their hospital pharmacist counterparts.

Across both sectors there appeared to be very few respondents that had reported having completed formalised training. Some respondents reported that sites had a protocol for NOAC training, but this appeared to be both sporadic in that there was variation between individuals from the same site and also localised with different protocols and methods across those from different sites. There was no evidence of consistent delivery of NOAC education and training.

Considering the perceived confidence of the respondents to conduct NOAC counselling by qualification status, pre-registration trainees appeared to be slightly less confident than qualified pharmacists, although any difference is small. This is reasonable considering the stage of career that those in each of these groups are at, particularly as pre-registration trainees are still in a learning role and are largely, only just, applying their knowledge from university to day to day practise as a pharmacist. Overall, the median for confidence for the whole sample was ‘‘quite’’, which is somewhat better than expected especially considering that the median for how frequently the respondents conduct NOAC counselling was ‘‘occasionally’’. This is surprising, firstly because NOACs accounted for over 4.5million items dispended in community pharmacies in 2018 (NHS Digital 2018) and so are a common medicine, yet the respondents reported only ‘‘occasionally’’ counselling on their use; secondly, it is also somewhat surprising that on the basis of an ’occasional’ activity that the respondents were still ‘‘quite’’ confident.

If considered in isolation the results for the question on confidence in NOAC counselling could suggest there is no need for the VP as more than 75% respondents rated their confidence as

moderate or greater. Despite this, there was over 90% agreement that learning more on NOAC counselling would be ''quite'' or ''extremely'' useful (Figure ***6.6***). These results suggest that irrespective of how confident the respondent was or how often they do NOAC counselling, respondents still tended to think that it would be useful to learn more. This could also be linked to previous NOAC training, in that there was such interest in learning more because a large proportion of the respondents had not reported received any particular training in this area previously.

Many of the free-text responses regarding the potential impact of the VP related to an increase in counselling standards and thus improved patient care. This suggests that respondents do see a purpose and consequence of using the VP that may benefit their practice and patients. A number of respondents directly related the use of the VP to either pre-registration training or as part of CPD, these ideas of incorporation of the VP into education and training were further explored in phase two of the study.

Some respondents mentioned how the VP might fit into current practice and they seemed to accept it as a learning resource for implementation. This was sometimes to the detriment of other resources, such as respondents suggesting that the VP may be more engaging than alternative learning methods for example, presentations and roleplay. The value of VPs compared to alternatives is a topic that a number of previous studies have attempted to quantify (Battaglia *et al.* 2012, Douglass *et al.* 2013, Bindoff *et al.* 2014, Smith *et al.* 2014, Zlotos *et al.* 2016). Across these studies the findings are conflicting regarding the educational value of VPs. VPs were not found to be any less useful to alternatives and they were often more well-liked. Bindoff *et al.* (2014) appeared to be the only study to statistically demonstrate an advantage of VP use compared to a paper-based alternative and even so this study had limitations to this finding as discussed in section 3.4.3. The findings of this study support that VPs are well liked but no judgement of its value compared to alternative resources can be made.

From the results of the questionnaire phase one question that remained concerned the perceived purpose of the VP. The ranking question (Figure ***6.11***) had a range of results with some respondents identifying VP use for NOAC-specific knowledge and confidence outcomes and others for more generic counselling outcomes or CPD. Whilst this question contributed to establishing the overall interpretation of the purpose and educational value of the VP, it was also clear that in some cases the purpose or outcome of using the VP was individualised. This issue was explored further in the interview phase.

There were several VP improvements and recommendations made by the respondents. These included changes to reflect the potentially restrictive nature of the VP, particularly through the MCQs and the underlying algorithmic design. Some changes to support learning were also discussed, this included adding more references and supporting documents. Respondents appeared to like the idea of a summary at the end of the application regarding the 'desired' consultation, although this does somewhat conflict with the educational 'purpose' of the VP and the exploratory focus. This will be discussed as part of part two of the study (section 8.3). As highlighted across this discussion, a number of areas were identified as having mixed views, such as the feedback style (visualised in Figure ***1.8***), these areas were addressed in phase two of the study.

6.11 Questionnaire performance

The study questionnaire appeared to perform well. There was a small problem associated with technological access to the questionnaire from inside NHS Trusts which was easily resolved and managed via communication with the individual sites affected. The data received from the questionnaire appeared to answer the questions that they were designed to answer.

A Cronbach alpha test was conducted to indicate the internal consistency or correlation of the Likert scales in the questionnaire (DeVellis 2003, Field 2013, Scott and Mazhindu 2014), this was undertaken for both the pre- and post-VP questions. When interpreting the results a score

of 0.7 was taken to be the threshold for good internal consistency (Campbell *et al.* 2007, Field 2013, Scott and Mazhindu 2014). When this threshold is reached it means that the items of the Likert can be grouped together and used as a single overall score (Scott and Mazhindu 2014).

The results of the Cronbach alpha test suggested that the part of the instrument where the Likert scores were grouped had a high level of inter-reliability (α=0.915 pre-VP; α=0.914 post-VP) as the Cronbach alpha score was greater than 0.7 (Table ***6.4***) this indicates that merging scores into a pre- and post-VP scores was appropriate. These scores were similar to the pilot scores (α=0.916 pre-VP; α=0.906 post-VP) and this further helps to establish that the use of the Likert scales was appropriate.

	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
Pre-VP Likert	0.916	0.915	11
Post-VP Likert	0.906	0.914	11

Table 6.4 Cronbach Alpha analysis of the grouping of Likert scales measuring self-reported ability

Furthermore, there did not appear to be any presence of acquiescence bias in the responses as no respondents were repeatedly giving the same response in a way that suggested 'yes saying'. This was particularly evident from the difficulty question where the users had to read and understand the question to provide an answer in keeping with their other responses. A few individuals appear to have selected almost identical answers to each usability question but, using the difficulty question as an indicator, no single participant gave an answer to this question which suggested that they did not read the question or select a response without engaging. Where respondents did indicate they found the VP difficult to use this was alongside other responses or free-text comments that suggested that this was a genuine response.

These observations and results of questionnaire performance have demonstrated the robustness of the instrument, so that it is suitable for use in the study. The instrument has been transparently discussed (section 5.4.2) and the approach to developing and using a quality instrument further strengthens the quality of the research, this was an something undertaken on the basis of the results of the systematic review (section 3.5.2).

6.11.1 Strengths and limitations of the questionnaire findings

The questionnaire phase of the study had a number of strengths and limitations. Firstly, the study aimed to discuss the approaches to quality which were used to develop the questionnaire instrument as this is one area which has been lacking in previous studies (Richardson *et al.* 2019). As discussed in the previous section, the questionnaire instrument is a strength of the study as multiple approaches to quality have been adopted, examples being the use of a peer review and piloting (section 6.11).

Considering the measured average improvements in self-reported ability, the inclusion of the median value supported the use of the mean calculation as the two were very similar. This suggested there was little difference between treating the data as interval by using a mean calculation versus treating the data as ordinal and using a median calculation. This strengthens the analysis of this part of the data as there was clarity as to whether to treat the data as ordinal or interval.

The process of completing the questionnaire, rather than using the VP, may have also made respondents more aware of what is to be included in NOAC counselling and could have adversely affected their perceptions and subsequently the questionnaire results. This is one example of construct validity and a potential limitation of the questionnaire phase. Despite this, there were no other apparent alternative options to evaluate the VP in a manner that would not have had this effect. The majority of the questions pertained directly to the VP and so any effect due to potential construct bias was likely to have been small.

Participant recruitment was slightly lower in the community sector (n=26) than the hospital sector (n=61); a number of respondents (n=7) worked in multiple sectors or it was difficult to establish which sector they identified themselves as working in. Due to this the split of participants across the study by sector not being equal this may be seen as a limitation. Despite this, the results have demonstrated that there is very little difference between the groups split by sector or by qualification status (section 6.8 and 6.9). Similarly, there was a lower number of male respondents and of older ages and this could have resulted in underrepresentation of these groups and affected results. The extent of this is unknown, however, the GPhC's annual report on pharmacy registrants for 2019 shows a split of 62% female to 38% male pharmacists and that aged 25-34 years is the largest age group with sizes reducing gradually to only 15% of pharmacists being over age 55 years (General Pharmaceutical Council 2019a). This data is in line with the sample used in the questionnaire phase and suggests that rather than a limitation this sample is representative of the pharmacy work force and therefore could be considered a strength. A similar pattern exists for pre-registration trainees (General Pharmaceutical Council 2019b).

6.11.2 Implications and next steps

The results from this chapter and the first phase of the study highlighted a number of areas that were investigated further in the interview phase. These were the areas that had a wide range of responses across the Likert or received a high volume of free-text comments. This allowed for an exploration of the range of perspectives on these topics and helped to identify the underlying perspectives on certain elements of the VP as explained in the subsequent chapters.

To summarise, the areas identified for further exploration in the interview phase were as follows.

- Performance feedback

- MCQ options and style
- The range of VP users and who is best suited to use the application
- Use of resources and references
- The frequency of VP use

6.12 Summary

From the questionnaire results, it appeared that most respondents liked the concept of the VP and found it usable. Some individual respondents were positive towards the VP and found very little wrong with it. Others were more negative, and a group of respondents had particular problems with the previously mentioned design areas. Some improvements have been suggested which will be further explored in chapter 10. The majority of respondents thought the VP had educational value and impacted either, or both of, knowledge and confidence. The questionnaire results also suggest that the VP could have more impact for pre-registration trainees than some qualified pharmacists; this is not entirely clear and will be further investigated. The next chapter moves to discuss the second, qualitative phase of the research and demonstrates how key findings from the questionnaire have directly informed the interviews.

7 Interview results I. does the VP work?

7.1 Introduction

This chapter moves on from phase one of the study to present the first results of the second, interview, phase. The interview phase uses the questionnaire findings as a foundation to further explore perspectives on VP use and to expand on and consider in more depth, the initial results. This chapter will first present the interview process and participant information. The interview themes are split into three categories as follows 'Does the VP work?', 'How does the user experience the VP?', and 'Where can the VP fit into practice?'. This chapter presents and discusses the first category of themes, chapters 8 and 9 will complete the presentation and discussion of the interview results.

7.1.1 Aim of the interview phase

Considering the aim and objectives of the wider study, the interview phase specifically aimed to further contribute to investigating the learner reported value and acceptance of the VP, more detailed exploration of perspectives on the satisfaction and the usability of the VP, and of the usefulness and ability of the VP to teach NOAC counselling and improvements to the VP. Additionally, this phase aimed to identify ways in which the VP can be incorporated into the education, training and CPD of pharmacists and pre-registration trainees particularly considering the VP audience and purpose.

7.2 Results

The interview phase of the study took place from March to August 2019, during which time 17 audio-recorded interviews were conducted over the telephone, one over video-technology and four in person. The average length of interview was 31 minutes. The interviews used a semi-structured approach making use of the interview guide discussed in section 5.5.1. The lead investigator, CR,

conducted all of the interviews; audio recordings were transcribed verbatim by *The Transcription Company* and checked for accuracy by CR.

Following thematic analysis, 11 themes emerged across 3 groups (Table ***7.1***), A number of sub-themes were also included as part of the themes. The themes are presented and discussed across the next three chapters; a brief discussion of each group of themes is presented at the end of each interview results chapter.

- 'Does the VP work?'
- 'How does the user experience the VP?'
- 'Where can the VP fit into practice?'

7.2.1 Participant demographics

A total of 22 participants were interviewed, 17 (77.3%) participants were from the hospital sector and 5 (22.7%) from the community sector (Table **7.2**). One participant had considerable additional primary care experience and a number of hospital participants has also previously worked in the community sector. Two participants had recent rotational, or specialist roles in anticoagulation. There was a minor difficulty in recruiting community-based pharmacists compared to hospital-based ones but, those that were recruited were proportionate to those from the first phase (phase one, hospital 64.8% vs 27.7% community; phase two, hospital 77.3% vs 22.7% community). There was a split between qualified pharmacists and pre-registration trainees of 14 (63.6%), to 8 (36.4%) respectively. This is reflected in the age groups of the participants as the largest group was 20-29 years of age (13, 59.1%). One pre-registration trainee was a qualified overseas pharmacist completing pre-registration training to meet the requirements for U.K. practice.

Category	Theme	Key discussion points/descriptor
A. Does the VP work?	A.1 Running of the VP	Does the technology work and did it function? Accessibility as a mobile resource
	A.1.1 Technological improvements	Improvements identified relating to the technology and running of the VP
	A.2 Technological realism and immersion	Realism and immersion of the technology, animations of the patient character and of the environment
B. How does the user experience the VP?	B.1 Realism compared to pharmacy practice	Clinical content, accuracy and realism to practice, realism of Henry as a patient
	B.1.1 Restriction	How the restrictive nature of the VP affects its acceptability and realism
	B.1.2 Case difficulty	The difficulty and complexity of the application
	B.2 Facilitating learning	How do participants perceive use of the VP? Considers alignment with ILO and if the users had the same perception on the ILO
	B.2.1 The VP as an adjunct	How the VP compares to other resources and how it is accepted by the users
	B.2.2 Ways of using the VP	How do users use the VP? Including is it a test, 'right' and 'wrong' answers and frequency of use
	B.2.3 Performance feedback	Perspectives on the feedback design and its usefulness
	B.2.4 Improvements to enhance learning	Improvements concerning the learning experience and value (includes the addition of references/resources and signposting for further learning)
	B.3 Wider benefits	Benefits wider than individual users around workforce consequences
	B.3.1 Other possible VP applications	Participant suggestions of future VP use
C. Where can the VP fit into practice?	C.1 Implementation into pharmacy practice	Considerations for how to implement the VP into pharmacy practice
	C.1.1 Continuing professional development	How VP use links to CPD
	C.1.2 Pharmacy sector	Implementation considerations for pharmacy sectors
	C.2 The 'Ideal' user	User perspectives on VP use for different types of user

Table 7.1 Themes resulting from Framework analysis of interview data

Interview number	Participant number	Gender	Age group	Qualification status	Sector of practice	Further comments
1	14	Female	20-29 years	Pharmacist	Hospital	Recent anticoagulation rotation
2	21	Male	30-39 years	Pharmacist	Community	Offers a warfarin service
3	5	Female	20-29 years	Pre-registration trainee	Hospital	
4	30	Female	20-29 years	Pre-registration trainee	Hospital	
5	54	Female	20-29 years	Pre-registration trainee	Community	Overseas pharmacist
6	17	Female	20-29 years	Pharmacist	Mixed (primary care, hospital)	Primary care experience
7	7	Female	40-49 years	Pre-registration trainee	Hospital	
8	6	Female	20-29 years	Pre-registration trainee	Hospital	
9	57	Female	20-29 years	Pharmacist	Hospital	
10	11	Male	30-39 years	Pharmacist	Hospital	Education and training role, interest in anticoagulation
11	58	Female	30-39 years	Pharmacist	Hospital	
12	35	Female	20-29 years	Pharmacist	Hospital	
13	39	Male	50-59 years	Pharmacist	Community	
14	67	Female	30-39 years	Pharmacist	Hospital	Specialist anticoagulation pharmacist
15	43	Female	20-29 years	Pre-registration trainee	Hospital	Previous community experience
16	50	Female	20-29 years	Pre-registration trainee	Hospital	Previous community experience
17	73	Female	20-29 years	Pre-registration trainee	Hospital	Previous community experience
18	74	Female	20-29 years	Pharmacist	Community	Academic experience
19	77	Female	30-39 years	Pharmacist	Hospital	
20	80	Male	20-29 years	Pharmacist	Hospital	
21	75	Female	30-39 years	Pharmacist	Hospital	Education and training role
22	83	Male	50-59 years	Pharmacist	Community	

Table 7.2 The demographics of interview participants

7.3 Does the VP work?

The technology used to create and deliver the VP was a significant discussion point within the interviews. This covers two themes: running of the VP (section 7.3.1); and technological realism (section 7.3.2). The first theme addresses views around whether the technology was functional, and the second theme addresses wider issues around the users' views of the realism of the technology. There was one sub-theme associated with these themes: technological improvements.

7.3.1 Running of the VP

The VP technology appears to be functional and most users reported good access and that they could use it without problems. A small number of individuals reported technological issues which potentially limited use. Overall, there is evidence that the VP is user-friendly but there could be scope for clarity regarding how to use the VP.

The first significant discussion area concerned the technology of the VP, whether it functioned and if it was usable from the participant's perspective. A majority of the participants reported that they had encountered no technological issues and had found that the VP was functional, as the following quote illustrates.

> *''Yeah, well I used it on an NHS desktop, so it wasn't particularly modern, so it worked fine, yeah, I didn't have any difficulties.''* [P11]

A minority of participants did encounter technological issues of varying types. These included problems accessing and running the VP although it was not clear in some cases why this had occurred and could have been due to anyone of a number of reasons including the VP application, and/or the device being used.

> *''So, the first time I did it, it was absolutely fine. Er, it worked like a treat. Erm, however, when I... went back on that same computer to use it, it did freeze, and it kept freezing which was frustrating...''* [P35]

Some participants also reported parts of the VP being slow, this appeared to not be due to the technology but rather the design and the speed at which the application had been programmed to deliver aspects of the case.

> *''I think it was more that the patient was talking slow and…everything else was fine and the whole programme went fast and everything.''* [P50]

The next most common discussion area concerned access to the VP. This was not raised by a large group of participants, but those that did, all said that access to the VP was at least adequate; no one reported a negative experience of this.

A minority of participants reported that they had accessed the VP via mobile devices including mobile phones. These participants spoke in overwhelmingly positive terms about this mobility. However, the majority of participants did not comment on this as they did not appear to have tested this feature.

> *''Yeah, I mean because it's digital, you can use it anywhere really, bottom line…I think it's fantastic. I think I love how you can get it up on different devices''* [P17]

Focusing on the reported perspectives on VP use, a number of participants explicitly expressed that they thought the VP was user-friendly.

> *''No, I think that was more or less it, it was user friendly, it was quite straightforward to actually use the programme.''* [P14]

Technological improvements

Across the interviews, all participants suggested forms of technological improvement to improve the VP user experience. These ranged from minor adjustments where the user experience was thought to not be optimum to more significant changes which could affect technological delivery of the VP. In the majority of instances, the participants still found the VP to be useable without the suggested changes being made. This was shown in what participant 35 said on this issue:

> *''I think it's [the VP] a very good idea. I think it's something new and it's something different and I do think, you know… I'm highlighting issues that it can improve. Erm, otherwise if I say everything positive, there's no improvement. It's constructive criticism''* [P35]

Another example concerned improvements to the speed of the patient talking:

> *''maybe have the patient speaking a bit faster and have the subtitles coming as he's speaking.''* [P50]

The single largest technological change that was most frequently talked about was the possibility of introducing a 'back' button so that the user could return to previous decision points within the application. The majority of participants who raised this idea, particularly of pre-registration trainees, favoured it as shown in the following quote:

> *''I don't know if there was an option to go back and change your option. I feel like there wasn't so if you had made that decision you wasn't able to go back so maybe that would be something to consider.''* [P5]

For those who thought a back button was a good idea, the reason appeared to be because they could rectify their consultation if they thought it was going less than optimally. One

participant stated that they thought this was a good idea because at one point they clicked an option they weren't intending to.

On the other hand, some participants said that use of a back button was not a good idea. The commonest reason for this was that there is no such thing as a 'back button' in real-life practice.

> *''In a way, from a technological perspective, probably it would be useful if you could go back. But in real life, if you start a consultation and you said something or you make a decision, how do you backtrack? Like you can't really, or you just have to rectify it as you progress. So, I think – well I suppose from the user-friendly point of view it would be nice to have as an additional option, but in reality, it doesn't happen.''* [P74]

In a small number of instances there were a number of issues that seemed to have caused frustration about the algorithmic nature of the VP design, as shown in Participant 35's comment below. The limitations of this and improvements will be further discussed in section 7.3.2.

> *''Erm, for me, it was, like I said, something different, something new. It was - and it was exciting. However, it was almost pre-set and, like you said, algorithmic where it's just almost like - 'Okay, this gives this, and this gives this.'.''* [P35]

7.3.2 Technological realism

Technological realism includes a number of elements namely, realism of the technology as an environment simulating real life and the realism of the VP character as a person. All of the participants appeared to like the overall idea and concept of the VP and part of the reason for this appeared to be due to the technology, within the conversation around likability, most interviewees reported liking the VP because it was ''quite lifelike'', for example:

> *''It was quite lifelike. I did enjoy that, but it doesn't - it's not like it's - erm, it's not too fake, if I can put it that way?''* [P34]

Other points made concerning technological realism included the novel nature of the VP technology, and the high-quality technology and animations. This appeared to be well liked by participants, as shown in the following quote:

> *''I liked the way it worked, actually. I, I thought, you know, having the patient - I mean I, I played it through one time erm, somewhere where I could actually hear the person talking… but I actually quite liked that sort of interaction side of things with the patient, where you feel like you are - you know, the guy - er, making expressions as well. So, you know how happy or unhappy he is and what you're saying and you're getting that feedback''* [P58]

Another participant said that the VP was ''uncanny'', and it appears that the virtual nature and realism of the patient interaction had made them feel uncomfortable. However, despite this, they said that they thought that it was ''good'' and ''authentic'':

> *''Erm it was a bit erm, it looks a little bit uncanny really when the gentleman, the virtual patient is… it's very good, like the reactions are very good but it's just a bit uncanny erm but it's a good way of representing it and so it looks good, it looks like a… in a virtual environment, the consultation room needs to look good when you take a patient in there, it's very authentic.''* [P11]

Technological realism could also be seen in the way that many participants appeared to identify with the VP character of Henry as a person. Some participants appeared to have identified with the realism of Henry to the point where they recognised different types of response:

> *''Yeah definitely, cos if you accidentally click the wrong thing you don't get a great response from Henry.''* [P73]

Conversely, a number of participants appeared to suggest that the VP had limited immersion due to it being a computer, and not a real patient, although some participants did recognise that the VP was always going to have this limitation. Participant 34, focused on this from a rapport building and non-verbal communication perspective:

> *''because it's a virtual patient, you, you can't really erm... there's a lot of room for sort of er, a, a casual conversation, you know. Erm, yeah, so I mean there was a few things but there's - unfortunately, that's something that's going to get lost in technology, you know; the friendliness or the erm... er, the jokes, you know...''* [P34]

One participant appeared to think the VP was not realistic saying that it was ''impersonal'', although, this participant did seem to appreciate that this was because the VP is a computer simulation:

> *''I feel like it's more personal when it's a patient. I felt this was impersonal, but it would be because it's a virtual reality programme erm, and... there is scope for this, if this was developed properly. I think its early days… it lacks personality. It lacks emotion.''* [P35]

7.4 Discussion

The VP was reported to have good functionality and usability in that the majority of participants could access and use the VP, although a few technical problems were reported. These need rectifying as technical limitations can detract from user experience (Ellaway *et al.* 2009). Considering the technology in detail, a number of users highlighted that they thought that the VP was user friendly. This differs from the study by Bindoff *et al.* who found that due

to their VP design the users had an adjustment period which somewhat distracted from usability (Bindoff *et al.* 2014). Although as Bindoff *et al.*'s VP used computer game navigation and thus it is not directly comparable to the technology used in this study, the navigation choice may account for the adjustment period. In this study the participants did not appear to have to adjust to using the VP and the VP was reported to be, in the most, user-friendly. This is encouraging as Taglieri *et al.,* pointed out that familiarity with the technology can improve learning (Taglieri *et al.* 2017) and thus usability could potentially impact user learning outcomes.

The VP was also cited to have lifelike animations, which contrasts with the work by Jabbur-Lopes *et al.* (2012) who suggested that VP animations can be limited. This review was previously discussed in section 2.4.4 where it was highlighted that of the studies included in the review, most of them used now out of date technology and so the recommendation for more sophisticated graphics is unsurprising. The results of this study contrast with this finding and suggest that the animations were sufficient; it could be that this VP uses animations of a higher quality. However, building on this, the animations although lifelike, may benefit from running at a faster speed as for a minority of participants the current speed appeared to affect usability.

The VP was identified by a minority of participants to have limitations in simulating non-verbal body language such as eye contact. This is especially relevant as body language is recognised to be an important factor in consultation skills (McDonough and Bennett 2006) and previous VPs have also been limited in this area (Stevens *et al.* 2006). Similarly, one user discussed that elements of building rapport such as jokes was lost when using the VP. Building rapport is a key part of effective consultations and this would be difficult to incorporate into a simulation particularly those using multiple choice rather than free text questioning designs. One study recognised that building rapport was the most significant skill to master for effective communication (Hargie *et al.* 2000). As rapport building is so significant in developing

communication skills it is surprising that this has not been investigated in the context of VPs; the opportunity for rapport building within a VP interaction is relatively unknown. This may be due to the ability of the VP technology currently being the limiting factor for using VPs to develop rapport building skills within a consultation.

A majority of participants recognised that some of the limitations around realism were a part of simulation technology more broadly and could not necessarily currently be technically overcome. One participant did highlight that Henry has different expressions as part of the application and identified these non-verbal responses in a positive manner. The VP was also positively described as ''authentic'' and ''genuine''. Authenticity of VPs was considered in the concept map by Hege *et al.* (2016), where it was recognised as being ''critical'', this was linked to wider concepts of realism which will be further discussed in sections 8.2.1 and 8.3.

The suggestion to include a back button within the VP interface was made by a number of participants. As already highlighted, in the study by Bindoff *et al.* (2014), a similar usability issue was reported as navigation around their VP used computer game navigation and this limited user's acceptability of the application. This study demonstrated that a design feature of an application can detract from use to the point that it affects usability. Therefore, changing the VP's interface to improve navigation may better optimise user experience.

Despite this, from an educational point of view, use of a back button may not be in keeping with the purpose of the VP, as was evident when participant 74 stated there was no such thing as a 'back button' in real life. The current lack of a back button does not appear to be prohibitive of VP use but perhaps an alternative way of improving the navigation of the system could be made as to minimise any negative effects of changing the navigation. This should be done in a way which considers both the user experience and the purpose and educational principles of the VP.

An advantage of VP use which was demonstrated is that of mobility and accessibility. The mobility of VPs has not been a widely documented advantage of VPs, especially as a number of previous VPs were not designed to be mobile, partially due to previous technological constraints (Stevens *et al.* 2006, Shoemaker *et al.* 2015). This study demonstrates that users favoured that the VP was available on mobile devices and could be used anywhere without any specific requirements. This demonstrates a practical opportunity for incorporation of the VP into education and training and also an opportunity for future VPs to be also developed to be mobile. The VPs in the work by Bindoff *et al.* (2014) and Shoemaker *et al.* (2015) used common web browsers to host their VP with no specialised equipment; although this was not evaluated directly the authors stated that this was intended to increase usability. Similarly, Douglass *et al.* (2013) and Kononowicz *et al.* (2014) cited that VP technology has advantages around mobility but did not expand any further; this did not appear to have been incorporated as a measurable outcome in to any of the VP studies. Despite this, the results of this part of the thematic analysis appears to be one of the first studies to consider the mobility and accessibility of a VP and reports direct findings around this issue. On this basis, mobility maybe an increasingly important issue to consider when designing future VPs.

7.5 Summary

This chapter has presented and discussed the interview participants and the results of the first category of the thematic analysis. This builds on the previous chapter where the questionnaire results provided areas for further investigation. The themes were discussed relevant to the study's overall aim and objectives, and key results have been highlighted. The next chapter moves to present the next group of themes.

8 Interview results II. how does the user experience the VP?

8.1 Introduction

The next stage of this thematic analysis moves past discussing the technology of the application to focus on the next category of themes. This category concentrates on the educational uses and benefits of using the VP.

8.2 How does the user experience the VP?

The three themes of this group are: realism compared to pharmacy practice (section 8.2.1); facilitating learning (section 8.2.2) and wider benefits (section 8.2.3). There are also a number of sub-themes which will be discussed.

8.2.1 Realism compared to pharmacy practice

Realism compared to pharmacy practice incorporated a number of points around the realism and accuracy of the clinical content of the application and of Henry as a patient. There were mixed views on whether the VP application was realistic. Some participants recognised that the VP was an educational resource and thus it was not trying to portray a pharmacy environment with complete accuracy.

> *''As an education tool I think it's very useful. Erm and I think that's what it aims to be. It's not trying to make out that you know, this is what really happens.''* [P83]

Despite this, some participants were concerned that the VP was not realistic to all pharmacy practice.

> *''It should be more like - okay, if you're in this situation, … if you've got a consultation room, it would be nice to have them in there. However, you know, some pharmacies may not have them…you can't really penalise or flag it up to say, 'Actually, it's incorrect, and red, and harsh,' because actually, each environment is different.''* [P35]

Furthermore, building on one of the 'worst' elements of the VP identified in the questionnaire (section 0), the length of time to counsel the patient was discussed multiple times and that this maybe unrealistic of practice. This is highlighted in the following quote from the perspective of a community pharmacist:

> *''perhaps it needs to be highlighted that this is an ideal situation and you're fully aware that this isn't gonna happen practically, but in an ideal world this is what we would like to happen, which is fine…the reality is very different.''* [P36]

A significant part of the discussion of realism concerned clinical accuracy. There were a group of participants who raised issues with the clinical aspects of the application, and they suggested improvements to make the VP content better representative of clinical practice. It tended to be longer qualified or specialist pharmacists with this perspective.

A number of participants expressed concerns that the information provided about the medications were not reflective of real patients and current practices:

> *''When you have a, a diabetic patient, who's got AF, there should be other medications that should be prescribed. You know, you have - you haven't got your rhythm or rate control. You haven't got your Bisoprolol. So, for me, there was - it, it - clinically, it wasn't accurate. You can tell that they're focusing very much on the counselling which is fine erm, but in a real patient, you won't just have, you know, a diabetic who's Type 2 with AF. They'll have, you know, other co-morbidities or er, more of a pharmaceutical challenge.''* [P35]

The next discussion within the theme of realism to pharmacy practice concerned the patient, Henry. A number of users suggested that Henry asked questions similar to real patients. Although it was also suggested that Henry was a 'perfect patient' in that he only asked fairly straightforward and reasonable questions.

> *''[Henry] asked me questioned that I'd sort of expected him to ask…I think that is a good starting point.''* [P57]

Although, in contrast, the view was expressed that Henry was one individual patient and it was suggested that sometimes patients do not want the level of information incorporated in the application.

Restriction

A sub-theme within realism concerned restriction as many of the users perceived the VP to be restrictive and thus this affected the realism and acceptability of the application.

Of the group that thought that the VP was restrictive there was a split concerning if this affected learning. Some participants specifically identified that despite some restrictive characteristics this would not affect the outcome of the application.

> *''Yeah, overall it probably didn't impact in the learning. Yeah, so it was probably alright, but some of [the MCQs] I just find that they were a little bit restrictive.''* [P74]

Equally, some participants expressed frustration that they could not control the flow or content of the consultation. Longer qualified participants tended to have this view.

> *''Yeah they [MCQ options] can be quite restrictive, you go down some ways and you are like, well I want to say something but all the options here are like err, they don't have the range of what I need, whereas like if you are doing a consultation, if you know you've missed something, you bring the consultation back''* [P11]

Conflicting with this, restriction was not always seen as a negative. As discussed in section 0, some participants identified that the VP was never going to be completely realistic.

One participant took a different view of this by saying that the restrictive nature of the VP may be useful as it directs the user to take the consultation in a direction they may not otherwise have done.

> *''it was interesting that some of the options…It sort of directed you maybe to choose one maybe that you wouldn't have chosen if it was sort of a free thing…[It] might've sort of led to a different outcome in the consultation.''* [P74]

Case difficulty

Most participants discussed the difficulty level of the application. This appeared to be multi-factorial and linked closely with the other themes and the wider concept of realism. Some participants agreed that the VP was of a suitable complexity and others thought that it was not difficult enough; no participants thought that the VP was too difficult.

> *''Yeah, I think it was challenging enough, without being overly challenging.''* [P83]

There did appear to be a slight difference between the participants across the sectors where community-based participants thought it was a suitable level and hospital-based participants wanted something more complex.

> *''it's good for general learning about counselling and for the initial stuff like asking the patient questions … but for, if it was something for like, something like this, for like a diagnostic thing, you'd need it to be a bit more clinical''* [P14, hospital pharmacist]

Moreover, one participant expressed that relative to community practice you would be unlikely to see more complex patients. This suggests that the difficulty level was appropriate for this individual.

> *''I don't think in the community setting you would get a much more complex case than what was in the technology.''* [P73]

Some participants discussed that they thought the VP case was too simple and should be altered to become more complex. Despite this, one participant recognised that even if the VP case is ''basic'' it was useful for reminding them of the basics which sometimes get forgotten. This participant was one of the longer qualified participants and this demonstrates a different perspective within this user group as the majority of the longer qualified pharmacists appeared to want a more complex case.

> *''Yes, the consultation stuff was a bit basic. And you know, it may need to be if people haven't done many consultations. Having said that, you can get very blasé and you know, it's no bad thing to sort of be pulled up''* [P36]

Views on case difficulty appeared to be linked to perspectives on the purpose of the VP, since a minority of participants seemed to assume that the VP was not difficult enough due to its clinical content rather than general aspects of consultation skills.

8.2.2 Facilitating learning

The intended learning outcome (ILO) of VP use was to ''learn how to counsel a new patient on rivaroxaban''. This theme firstly considers users interpretation of the ILO and if users reported meeting it. The VP appeared to be recognised to facilitate learning in a number of ways. These will be discussed alongside perceived improvements to better facilitate learning.

A significant number of participants reported feeling more prepared to counsel patients on NOACs as a result of using the VP.

> *''Erm, I think so [more prepared] because I feel like, erm, I know more about what information should be included.''* [P30]

Learning how to counsel on NOACs could incorporate a number of elements but most participants first picked up on increasing knowledge as shown in the following quote:

> *''For me, the, the main thing it focused on was erm, the, the rivaroxaban and, you know, how - erm, how it works; how the counselling for that specific erm, medication is more than just general erm, counselling skills.''* [P35]

However, one participant added that having a baseline knowledge was needed prior to using the VP.

> *''I think it could be quite difficult to - if you didn't have any basic knowledge to go straight into using the tool... because you do need to know about the side effects erm, like why patients might need to go to like a Walk-In Centre or might need to seek urgent help.''* [P53]

In addition, multiple participants (n=5), used the term ''refresh'' to summarise their learning.

> *''Erm, I wouldn't necessarily say that I learned it. I think it was more a refreshment…''* [P57]

Considering this more, this included contextualised learning.

> *''You can sit and just learn facts from a book, but you never in your head actually think about how you're gonna get that information across to the patient. Whereas with this you're forced to do that. So, when you do it for the first time it won't feel like you're actually doing it for the first-time cos you've already had a practice.''* [P73]

Most participants acknowledged that the VP may not be useful for only one type of learning but that it contributed to different elements of NOAC counselling. Participant 75 summarised this:

> *''I think it's hard to narrow it down to one area. I think it's probably a good combination of consultation and, and knowledge-based skills. It's down to the individual really and how they then apply that to real-life situations''* [P75]

A few participants seem to consider that the VP had particularly improved their consultation skills as the following quotes shows:

> *''I can see it being useful for… people who probably have got a lot of presumptions around their consultation skills … it has made me go back and actually look at um, the whole patient centred approach as opposed to um, as opposed to just, you know, spilling that knowledge and, and, talking to patients err, you know, as if it was if you're just trying to offload a lot of information on them''* [P83]

Notions of confidence were also mentioned throughout, which appeared to be intertwined with the other types of learning. One participant discussed how for them the learning was more about confidence than knowledge. Encouragingly, participant 57 reported confidence-based benefits to their practice.

> *''after using the tool I actually came across options where I could counsel a patient on a NOAC, and I felt much more confident.''* [P57]

The VP as an adjunct

This sub-theme concerns how the VP is largely seen as an adjunct to other education and training resources. It incorporates comparing and contrasting the VP with other educational resources used to learn about NOAC counselling. One participant discussed that the VP should be used alongside real-life experiences and not in isolation.

> *''I think you need to continue like the real-life thing, so actually having experience talking to patients in person. If you don't really get a chance to do that then, then there is an education tool but, erm, I don't think it should be solely relied on.''* [P5]

A number of specific education and training resources were mentioned. One participant thought that the VP complimented CPPE resources:

> *''there's a portal on CPPE and I think it complements everything else that I'm doing at the moment, to improve my consultation skills in this area.''* [P83]

This individual went on to note that the VP provides an ''extra dimension'' to learning and discussed the elements of the VP which make it more acceptable. They also appeared to suggest that the VP was more acceptable than roleplay.

A further participant similarly suggested that due to the nature of the application users would engage more and use the learning in practice:

> *''I think people would find it more interesting to use than just doing the basic kind of click through and answer some questions at the end type learning. I think it's probably going to engage people more and then they're more likely to remember what they've learnt from that kind of exercise and use it more in practice''* [P67]

The VP was also cited to have distinct advantages over inhouse training as it allows mistakes in a safe environment.

> *''we've got an in-house thing where they sort of talk to a colleague about [NOACs] before we let them talk to the patients but equally, you already know the information… you know what they mean and you won't necessarily – it won't always be picked up on. Whereas, I think that virtual patient allows them to make some mistakes and, and realise how would be a better way of saying things''* [P58]

Ways of using the VP

Within the conversation on VP learning it became apparent that there was a range of ways that participants used the application, including a range in the frequency of VP use. The majority of participants stated that they had or would use the VP more than once, although this was in a variety of ways. For some users repeated use was via an initial in-depth use followed by less formal follow up learning potentially from practice or patients:

> *''Yeah, I would definitely use it repeatedly…I always learn better when I've had an incident with a patient; you know, when they have asked me something and I've had to look it up, then it feels like I – I'll always remember it erm.''* [P34]

Two participants discussed that they used the VP more than once to achieve all 'green' feedback (feedback design shown in Figure ***1.8***). It appeared that the main reason for using the VP a second time was not necessarily for the learning but to get 'perfect' feedback.

> *''I did my second attempt also because … with the first one, there were still two things which were, had been highlighted in red or something like that and that's why I was thinking okay, why it's like that, so then obviously I'd gone back and then I learned that okay, patient can say this also…''* [P7]

From the other point of view one participant only visualised VP use as a single interaction.

> *''Erm, I think I would use it once just to have where my knowledge, like where, like whether I know all the information.''* [P30]

A number of uses commented that the VP had 'right' and 'wrong' answers. This appeared to affect the individual's perception and use of the VP and was closely related to getting 'perfect' feedback. Some participants appeared to think that there was a spectrum of answers within the case and that it may depend on personal counselling styles.

> *''Erm, maybe not right and wrong but, erm, but there was one option that was more of a cert whereas, so my option wasn't wrong, but it wasn't the preferred option.''* [P5]

Performance feedback

Feedback was one area that was identified from the questionnaire results as requiring further exploration in the interviews. As briefly highlighted in the previous sub theme, one element which was a particularly unexpected discussion point was the use of red and green colour coding to deliver 'good' and 'bad' feedback (as seen in Figure ***1.8***). A significant proportion of the users appeared to not like this method of feedback as they perceived the colour coding to categorise answers unduly:

> *''Like I just feel like the red shouldn't really be red. I think they should have killer points where, you know, 'Okay, you didn't - you forgot to say to have it with, with food.' Okay, yeah, that, that is a point. You know, that should be highlighted in red, if you've missed that… .like, 'You didn't offer me a seat' you know, and that would be red…Well, actually, you know, you gauge…they're not important points to put, to put a red, a red mark against erm.''* [P35]

In contrast, one participant stated that they were 'indifferent' to the use of the colour coding.

> *''I don't know, I think I'm a bit indifferent to that [the colour coding], I think just any feedback was good''* [P17]

Similarly, one interviewee positively highlighted that getting feedback on 'soft skills' in addition to the drug specific content was useful.

> *''So, I think the feedback was, was spot on really. Um, I liked how it gave you the feedback on your soft skills for consultations as well as medication related.''* [P17]

A number of participants discussed the usefulness of the feedback to improve their practice.

> *''I have already had a couple of consultations with patients since the first time, and I felt, you know, that it's, I've kind of built in some of the um, some of the advice and some of the feedback already.''* [P83]

Improvements to enhance learning

As part of the interviews, a number of participants made suggestions to improve and develop the VP educationally. As for technical improvements (section 7.3.1), one participant summarised their perspective towards improvements pragmatically discussing that improvements may be good but that nothing ''major'' should be changed.

> *''I don't think it's anything major that needs amending. I think there may be a few points to maybe kind of have as a summary, um, about maybe a bit more feedback as to why certain options might be the case with certain patients, um, and maybe like highlighting the key.''* [P75]

A small number of participants discussed the use of alternative questioning styles (n=5). Of these participants, there was most interest in the use of free text answers as an alternative method of questioning although often this was suggested in combination with MCQs.

> *''I think it should be a mix of multiple choice and free text erm there's no reason why you can't have both, obviously if everything was free text it would be quite long as well…but if certain points were free text that would be quite good''* [P14]

The possibility of incorporating further references and providing signposting for more learning was identified in the questionnaire results (section 0) and was further explored in the interviews. This was the most frequently mentioned change suggested for the application content, most participants expressed that they were in favour of this.

> *''Yeah, some references as well so…you've got this question wrong, you need to understand this, if you want to find the information this is the website you need.''* [P73]

There were a number of examples of the types of signposting and references to be included. This included key links for an individual depending on their performance like participant 73 stated above to local protocols and summaries of 'ideal' NOAC consultations; Summaries of Product Characteristics (SPCs) and NICE guidelines were not favoured. It appeared that in order for references to be useful they need to be contextualised and relevant for practice. They should also be accessible as some participants were unsure as to if users would actually make use of the references, despite this, no participants were opposed to this.

> *''Yeah, say if a certain area you've done bad in, if you could just get the link there and then 'maybe this could help'. Erm, I think it would be good if the link was there, if it's easy and accessible, if you could just click the link and go straight there, that's fine. But if you have to search it yourself, I don't think it will be any benefit.''* [P73]

8.2.3 Wider benefits

A number of 'wider benefits' to using the VP were identified. This included any type of benefit wider than individual users. The most frequently cited wider benefit related to consequences for the pharmacy workforce, particularly for the NHS. The user below commented on this and appeared to think that the VP offered an advantage as the VP is not labour intensive.

> *''you afford us a good training tool in a hospital because at the moment we have to organise quite labour intensive training sessions for our technicians to go on and a lot of people out of a ward, where pharmacists rotate technicians to train them on how to do counselling and a digital tool like this would be a great opportunity.''* [P11]

Consequences of the VP for the NHS from a patient safety and admissions perspective were also highlighted.

> *''it's a higher understanding of the medicine so it will hopefully lead to a lot less unnecessary hospital admissions for the NHS…patients do not take their medicine correctly and with high risk medicine like this you cannot afford that''* [P21]

General comments were also made regarding the VP aligning with the NHS' current drive to increase digital utilisation.

> *''as things progress within the NHS and stuff, we are trying to be more digitally advanced as possible so something like this is actually quite a useful tool.''* [P14]

Other possible VP applications

All participants suggested ideas for future and alterative VP applications. These included extended anticoagulation topics, and also topics completely unrelated to NOACs. A number of participants suggested extending the current VP to include other conditions where NOACs are used, namely deep vein thrombosis, and pulmonary embolism. An alternative suggestion was to involve patient characters with different needs in order to increase the range of information about NOACs that are covered in the scenario.

> *''It would be useful maybe to have maybe a young female who had a, a DVT [deep vein thrombosis] or something but is still having menstrual periods and… discussing that side of things and the pregnancy side of things as well because…obviously, you're never going to discuss with a man, it would be useful to have a variety of different patients, so you can discuss different scenarios with them because obviously, he was a walker who liked to hike but you might have, you know, like I say, the female or somebody who does - I don't know - snowboarding''* [P58]

There were also numerous suggestions regarding wider applications for the VP. The main topics that were cited were other high-risk medicines, complex counselling areas, and medications new to the market. Named medication classes which were suggested on this basis included insulin, inhalers and lithium. It was also suggested that a library of different VPs may be useful. Participant 75 summarised that there is a host of possibilities for the VP's future:

> *''Yeah. I mean I think it's, um, the kind of options are endless really. I think there's a lot of options where we could use it, you know, more, in more scenarios where in-depth counselling is required… there's lot, there's lots of ways we could advance this, you know, this option and, and apply it elsewhere.''* [P75]

8.3 Discussion

The interview results provided novel insight into how participants use the VP. The majority of participants appeared to see value in repeated VP use and this links to educational theory of experiential learning as part of a continuous cycle whereby users amend and then test mental models using learning from the VP and also from practice (Zigmont *et al.* 2011, Poore *et al.* 2014). This was especially evident when one participant discussed using the VP as a starting point and then reusing it after an incident with a patient. Similarly, a large group of users considered the VP as useful to refresh their ability, although this juxtaposes some of the evidence of exactly how the VP was used as it was reported that some individuals focused on 'getting a perfect answer'. There appeared to be a desire from a minority of the participants to 'perfectly perform' when using the VP. This could be evidence of 'surface' learning although others appeared more engaged and did demonstrate the ideas of 'deep learning' as described by Biggs and Tang (Biggs and Tang 2013). Deep learning can be described as a type of learning which ultimately contributes to a higher quality and understanding of the learning (Biggs and Tang 2013). Through the design of the VP as part of an experiential learning cycle this can encourage a deep approach to learning and the VP has demonstrated some of the elements to

deep learning including positive perspectives and a sense of importance of the learning (Biggs and Tang 2013).

Users tended to favour the opportunity to practice the patient interaction and, in the majority, they appeared to find the patient realistic and educationally useful. Some users seemed to perceive the patient to be a 'perfect patient', which may not be realistic of practice, but most of these users could see the necessity of this from an educational perspective. Some participants discussed elements of the VP which may not be realistic to all environments, this included differences between the perceived difficulty of the application between the sectors. Due to the constraints of the technology and because the VP is a learning tool some aspects will be slightly different from practice and so 'complete realism' maybe unattainable, this is further discussed in section 10.3.2.

Moving to explore the results around 'right' and 'wrong' answers to the VP, a number of participants expressed that the VP should have 'preferred' answers rather than 'right' or 'wrong' answers. This concept is in line with single best answer (SBA) questions. SBAs have a number of options, one of which is the preferred answer although the alternative options may not be technically incorrect (Sam *et al.* 2016, Dell and Wantuch 2017). This is an accurate representation of the types of questioning used in sections of the VP. For example, a question concerning missed doses of Rivaroxaban had a defined 'right' answer whereas other questions, for example regarding side effects may have had a preferred answer which balanced accurate information with delivering this information in line with needs of the patient. This also links to feedback as depending on the choices made the feedback changed. It is important that the VP demonstrates a range in delivery of, sometimes the same information, to allow for some flexibility in choice and also for the user to help develop their consultation skills. Some participants directly commented on this when they recognised that the VP helps to learn how to deliver information about NOACs to patients in a suitable way. Although in contrast some users did not appear to favour this approach and stated that the VP

was not clinical enough; it appears that these users did not appreciate the concept of SBAs in the context of delivering patient-centred, yet accurate information regarding NOACs. This was evidenced by participant 35 who sounded quite uncomfortable with the VPs approach to teaching when they stated that ''*They're trying to learn about the clinical aspect of this medication*''. This individual appeared to think that the VP was currently lacking in 'clinical aspects', when in fact, through use of SBAs, not only was the user faced with learning the correct information but also that different deliveries of the information may have different outcomes for the consultation. Despite this, the way that the feedback was delivered to consider the concept of SBAs could perhaps have be improved.

All of the participants valued getting feedback although the design and delivery of this could be improved. The use of feedback colour codes should be reviewed as the majority of users reported disliking this; a number of changes to the feedback options were suggested including reviewing the 'red' feedback points as not all of these were clinically incorrect things but also concerned consultation style which is much more fluid. Feedback is an important element of VP interactions and this needs to be developed in as much detail as the remainder of the VP (Botezatu *et al.* 2010, Bindoff *et al.* 2014, Hege *et al.* 2016). This is pertinent as feedback is a key part of the experiential learning cycle and it is during the debriefing stage that learning actually occurs via amendment of mental models (Zigmont *et al.* 2011). It is therefore important, that feedback is delivered in the best way possible to meet this stage of learning. Further considering the learning cycle, a minority of participants commented on the ways in which they have applied learning to practice. This demonstrates the value of the VP and suggests that the application did facilitate learning including learning which is relevant to practice.

Some participants were initially sceptical of the VP, but ultimately all the participants appeared to find a benefit in using the application, although the learning was not always knowledge based as some users expected. The VP was designed to be intentionally

exploratory and the ILO non-specific, but this was not clear to some participants as they perceived the learning to only be about knowledge, this may need to be more transparent in the future. The majority of learning appeared to incorporate knowledge, confidence and an opportunity to practice. Contrasting with other VP studies, this research has not attempted to overtly measure any of these outcomes as VPs have already been shown to be beneficial for these purposes as discussed in section 3.4.3. This study has gathered direct perspectives on what users think of this learning and how relevant it will be for their practice. Most users reported seeing a personal benefit to VP use; some users reported consultation-based learning benefits, for others it was about knowledge acquisition and application. No single type of learning or benefit to all users was clear, yet the VP has shown its value and acceptance by the majority of users.

Some users reported that the VP had advantages over other methods of teaching NOAC counselling such as role play (section 8.2.2) Despite this, a large proportion of users said that the VP would be best not used in isolation, but rather used alongside various other education and training options and the VP was largely seen as an adjunctive resource. This appears to be an original finding as the majority of studies in the literature on VP use focused on either the satisfaction of using the technology or use of the technology versus other methods such as paper-based alternatives (section 2.4.4). What appears to be absent is any other studies which found that VPs may be useful not in isolation but as part of a range of educational resources. A small number of studies have recognised that VP use is impacted by factors from practice but no study appears to have considered this in its methods (Fleming *et al.* 2009, Zlotos *et al.* 2016) and very little has been considered between a possible synergistic relationship of VPs and other learning methods. In the concept map by Hege *et al.* (2016) there is no mention of a relationship between VP use and practice; this is one area which requires further investigation.

A further advantage of VPs that was demonstrated is that of safety. This is a well-recognised design feature and advantage of VPs (Stevens *et al.* 2006, Zary *et al.* 2006, Thompson *et al.*

2016a) as is learning from mistakes (Cook and Triola 2009, Bindoff *et al.* 2014, Georg and Zary 2014), this was also a finding of the systematic review (section 3.5). The results suggests that the users felt in a safe environment to practice counselling, potentially more so than some alternative educational methods. Users appeared to value this opportunity.

A level of restriction within the VP, partly due to the design and questioning style of the application, was identified by a majority of users. For some this was negative, for others this did not appear to detract from their VP use. Within the literature there is little is documented on VP questioning styles but from a technical perspective, the results have provided insight into user likability of MCQs which appeared mixed. It is not clear how the different types of questioning may impact learning outcomes and there is little available within the literature on the perspectives of users on the alternative questioning types. The underlying algorithmic design of the VP should be reviewed to consider increased flexibility and reduced restriction. This should consider the educational principles of the VP, user experience and technical abilities. This multifactorial approach to the design of VPs is supported by Huwendiek *et al.* who stated that VP designs involve a range of factors including educational, design and technical elements (Huwendiek *et al.* 2009). This is further discussed in section 10.5.1.

A number of improvements were suggested to educational elements of the application, including increased transparency regarding the potential learning from using the VP and that this will not always be knowledge-based. Furthermore, the content of the VP should be reviewed as some participants, particularly the longer qualified or specialist pharmacists, raised concerns regarding the clinical accuracy of the application content. Any content of the VP should align with NICE recommendations for the treatments used in AF (National Institute for Health and Care Excellence 2014). Using the NICE guideline for AF management, and Henry's past medical history it would be expected that he would also be taking a rate or rhythm controlling medication such as a beta blocker for the treatment of AF, but this is currently absent (National Institute for Health and Care Excellence 2014). Furthermore,

someone with type 2 diabetes, as Henry has, would not normally be only on insulin, but rather a number of additional oral therapies and there may also be concurrent use of a statin (National Institute for Health and Care Excellence 2015b). The past medical history and medications of Henry should be reviewed to ensure, where best possible, that they are reflective of current U.K. practice and realistic, yet educationally useful.

Considering the possibility of further references to support learning as a change to be made to the VP design, there is limited discussion of this within VP studies and no other VP studies appeared to include references or further learning in their designs. Although the use of further references is commonly used in other pharmacy CPD resources such as CPPE modules, and so inclusion of this may better contribute to identifying the VP as a CPD resource.

Lastly, there are numerous possible applications which could be developed in the future and multiple topic ideas have been suggested; there was interest in a library of VPs. The literature for each of these should be considered prior to development of applications. It was also highlighted that the VP has almost unlimited potential as already recognised by Stevens *et al.* (2006).

8.4 Summary

This chapter has presented and discussed the results of the second group of the themes, these particularly related to the educational aspects of the VP and how participants used the VP. The next chapter presents the last group of themes and considers the implementation of the VP.

9 Interview results III. how can the VP fit into pharmacy practice?

9.1 Introduction

Moving on from the discussion of the first two groups of the thematic analysis, this chapter presents the final group. This category considers the wider implications for the VP and incorporates considerations for implementation. Due to this, the final group of themes is followed by a specific analysis of the interview results relative to an implementation framework. A discussion of the results of the last group of themes and of the implementation analysis completes the chapter.

9.2 How can the VP fit into pharmacy practice?

This group of themes relates largely to use of the VP in pharmacy practice which was discussed in varying forms by all participants. It is split in to two themes: implementation into pharmacy practice (section 9.2.1) and the 'ideal' user (section 9.2.2).

9.2.1 Implementation into pharmacy practice

A number of discussion points were raised that relate to VP use and the everyday practice of pharmacy this included ideas of implementation of the VP into specific pharmacy environments. As has already been discussed across chapter 8 there was a majority of positive comments regarding the potential of the VP but, what became clear is there was some unfamiliarity of how to start using the VP in practice.

> *''my feelings towards it are I'd feel like I'd want to use it, but I don't know how I'd start to use it.''* [P11]

A number of participants commented on the time commitments required to use the VP and the consequences of this on implementation. This appeared to be a prohibitive factor for these participants. This was also a result of the questionnaire phase of the study (section 0).

> *''Erm, I would possibly say it was a little too long. Especially if people are doing it in their own time... just from my experience, I worked in a really busy erm pharmacy…to have the time to even do things that you have to was a struggle.''* [P73]

Similarly, one participant recognised that different user groups may have different levels of engagement due to different consequences for the learning. This closely links with ideas of an 'ideal' user (section 9.2.2) and wider implementation strategy (section 9.3).

> *' 'cause you don't, as a student, you don't really care. You just want to get your grade and move on whereas as a pre-reg it's, 'oh well, I want to learn this for the exam'. And then as a pharmacist like 'oh, I'd better remember this again' 'cause I'm actually doing it''* [P57]

Continuing professional development

Building on ideas of integration of the VP into pharmacy practice, CPD was a significant discussion area. CPD was discussed by all of the participants and all of the participants could see some sort of purpose of the VP for CPD. No participants stated that the VP was unsuitable for CPD purposes.

> *''it would be quite a good sort of tick box for CPD and if… if this was available for different sorts of topics as well, you could do one topic as your CPD learning…''* [P14]

One participant detailed how they visualised the VP being used for CPD purposes. The comments of this participant link closely with the discussion in section 8.2.2 and this also maps directly on to the experiential learning cycle.

> *''for the CPD… I think it would be useful to say, you know, I've gone and - it's almost saying, I've gone away and learnt about X and then I've had a go on a simulator before I then went and used whatever information on - in the context of your work environment and sort of show how you've gone through that development process.''* [P58]

There were some participants who thought that for the VP to be used for CPD it needed changes or improvements to better align with the structure of CPD. It is not clear if all participants thought that these changes would be beneficial and conflictingly some participants stated that changes were unnecessary just to better align with CPD design. The changes discussed below link to the suggestion for further references within the application (section 8.2.2).

A wider issue that became apparent when discussing CPD was that there was confusion across the participants regarding what constitutes CPD and what an educational resource for CPD purposes should consist of. These perspectives occurred across the participants. Similarly, some participants, particularly those which were longer qualified, had comments to make on wider aspects of CPD. There seemed to be some frustration from participants regarding the process and value of CPD.

> *''I say, with a lot of CPD, I find it a joke. Erm, you know, doing modules… they tell you you've got to do CPD, so you've gotta do four modules, so frankly, you do four modules. And to a certain extent, that's not the point, is it? You should have the professional responsibility to already be doing CPD without it being a sort of statutory requirement.''* [P36]

Despite this, one participant said that they had used the VP experience as part of their CPD already.

> *''I am actually currently doing it as a reflection um, CPD anyway and I've tried to focus on AF in general, and sort of using it as part of um, of that.''* [P83]

Pharmacy sector

Pharmacy sectors and the consequences of this on VP implementation was a significant discussion point. In the most, participants commented on their own sector of practice and again similar to other discussions it was a topic with varied perspectives. The consensus of the participants was that the VP was applicable to both hospital and community sectors.

> *''I suppose the reality is that it looks like a community pharmacy, but I don't think that really matters or detracts from the overall usefulness of the programme.''* [P74]

Despite this, a few participants appeared to focus on the minutiae of the application content for particular sectors. In most cases, participants concluded that there is still transferable learning across the sectors.

> *''Erm, the way it is it's very community pharmacy based erm as a hospital pharmacist it's quite a bit different in terms of how we do counselling and consultations, a lot more in-depth, so maybe that's why I initially thought there's not so much clinical information in''* [P14]

An unexpected finding of the interviews was that there was confusion regarding who is responsible for providing NOAC counselling to patients. This was apparent when participants discussed use of the VP in different sectors; some participants seemed to think that it was primarily a hospital pharmacist's role and that the VP should reflect this. Others as already discussed, found benefits to the application being set in a community pharmacy.

9.2.2 The 'ideal' user

Ideas of who the 'ideal' user for the VP is came up in every interview with a range of perspectives. The participants had a range of ideas of who could use the VP, across the interviews, very few individuals discussed only one potential user group with most discussing that the VP was suitable for a number of types of user.

> *''I think whoever looks and uses this, it's always gonna be beneficial.''* [P73]

Pre-registration trainees were one group of participants specifically identified prior to this study as being potential users of the VP. All of the interview participants identified pre-registration trainees as good users for the VP. The most commonly discussed reason for pre-registration trainee use was because the VP acts as a refresher and/or prepares for practice.

> *''I think it's at a level where like a pre-reg pharmacist could do it and that would be useful''* [P67]

As well as pre-registration trainees, qualified pharmacist's use of the VP was one area that was a key part of the evaluation. All of the participants commented on this in some; many of the participants referred to qualified pharmacists in two broad groups: newly qualified pharmacists (normally classed as the first five years of qualification) and longer qualified or specialist pharmacists. Broadly, users thought that the use of the VP by newly qualified pharmacists was appropriate. There were mixed views regarding the use of the VP by longer qualified pharmacists.

> *''I'm saying newly qualified because for myself I knew it, but I had forgotten about it. It was a good refresher whereas once you've become a pharmacist for a bit longer you've had more chance to do it.''* [P57]

There were a number of participants that appeared to think that use of the VP by pharmacists with more experience would not be useful. One reason cited for this was the complexity of the VP case. This has already been discussed in section 8.2.1.

There were a few comments regarding the limitations of having newly qualified pharmacists as users of the VP as there is a potential for 'bad' learning; similar ideas were also presented for pre-registration trainees.

> *''Because I don't - I wouldn't really want people that are newly qualified to go by just this…It's almost like it's okay just to ask the bare minimum…''* [P35]

The next group most often discussed group was pharmacy technicians. Where pharmacy technicians were discussed it was suggested that pharmacy technicians are an appropriate user group.

> *''Counselling can be done by a technician and in that case, if it's just counselling about the NOACs, that can be easily done by them.''* [P35]

9.3 Implementation analysis

As discussed in section 5.6, on the basis of unexpected results that presented implementation as being significant to the use and uptake of the VP, a supplementary analysis specifically concerning implementation was undertaken. The analysis uses the CFIR and the results are discussed in the following section.

9.3.1 CFIR results

The CFIR was used to undertake the implementation analysis (Table ***9.1***). The CFIR uses five domains to address constructs which are needed for successful implementation. Table ***9.1***, presents the results of the CFIR analysis, the constructs have been mapped to the results of the VP evaluation to identify areas of the framework which are currently: being met; partially being met but in need of development; and not yet being met, these may be useful for future VP research and implementation.

Overall, of the 39 constructs or sub constructs, 19 (48.7%) were not covered by the study, 13 (33.3%%) were partially covered by the study and 7 (17.9%) were being met. This demonstrates that the majority of constructs are not yet being entirely met and suggests that further considerations may be needed to be made to ensure a successful implementation. Despite this, this was one purpose of conducting the CFIR, to identify areas which need development prior to the wider roll out of the VP. The CFIR analysis also provided an opportunity to identify any barriers to implementation from the current VP design, this will help to optimise the application design, not only from a

technical and educational perspective but also from an implementation perspective. Moreover, the analysis directly contributes to the study objective of ‘’*identify how the VP can be incorporated into the education, training and continuing professional development of pharmacists and pre-registration pharmacists*’’ (section 4.2).

The first domain, ‘’intervention characteristics’’, considers implementation with a focus on the intervention, in this case the VP application. A number of the constructs of this domain were being met, or partially met (Table ***9.1***). This included that there was an awareness of the relative advantages of the VP and its adaptability and trialability (constructs 1d and 1e). Areas which need further addressing include the perspectives of the participants on the external development of the VP (construct 1a) and users’ awareness of the literature base for its use (construct 1b). Cost is another significant factor which was not addressed in the study as all of the participants accessed the VP free of charge (construct 1h). It does not appear that the content of the VP itself is currently limiting the possibility of implementation but some of the supporting elements need development, particularly cost.

The second domain was ‘’outer setting’’ this covers some of the wider issues around implementation. No areas of this domain are currently being met and all need further development (Table ***9.1***). There is some evidence of the importance of NOAC counselling (section 6.8) but it is not clear if this is being prioritised by organisations and thus if there is sufficient interest for wider implementation of the VP (construct 2a). Participants identified NOAC counselling as important with potential benefits to both patients and organisations, but no information appears to be available considering organisational perspectives on the implementation of VPs. Furthermore, there does not appear to be any evidence of external policy and incentives to support VP implementation specifically (construct 2d), this may be a current barrier to implementation.

The ‘’inner setting’’ domain considers more closely the preparation for implementation on an organisational level. Large areas of this were not covered in the evaluation as the focus of this study

was not implementation within particular organisations (Table ***9.1***). Positive data were collected concerning the significance of the need for the VP by individuals, whereby the majority of users identified that there was interest in learning more about NOACs (section 6.3) (construct 3d). There were also a number of advantages identified for patients, this concerned an increased understanding of medicines which may have implications for their care (section 0). Where there needs to be further consideration prior to implementation this concerned cultural norms and how VP use will fit into organisations, including concepts such as rewards (construct 3d). This is significant especially as some participants expressed negative perspectives on CPD and mandatory training (section 9.2.1). Despite this, there were some promising discussions concerning where VP use may fit into CPD alongside other resources and this could be built in to the implementation strategy (section 9.2.1).

The penultimate domain of ''characteristics of individuals'' highlighted a number of areas which need further consideration (Table ***9.1***). One area which was not covered by the study but is significant for future use of the VP pertained to behaviour change and how use of the VP may lead to 'sustained use of the intervention' (construct 4c). This needs further development and consideration. Despite this, there were some areas within this domain where the VP performed well. As discussed in chapter 7, data were collected on the acceptability of the VP, this largely meets the CFIR requirements for ''knowledge and beliefs about the intervention'' (construct 4a). Equally data on engagement and learning styles of different audiences and groups contributed to meeting the ''personal attributes'' construct (construct 4e). Although this could be better developed moving forward to ensure that all named elements of the ''personal attributes'' construct are met.

The final domain of ''process'' was largely not covered by the evaluation as it also relates to organisational level implementation (Table ***9.1***). Some data were gathered on engagement and this was demonstrated through the course of the study where there was enough interest to recruit 94

participants (construct 5b). Equally the design of the study included a small level of implementation and utilised individuals to act as leaders and champions at each site (constructs 5b and c).

Reviewing the overall CFIR, large proportions of the framework were not covered by this evaluation, largely because implementation was not the focus of the study. Despite this, some foundations for a wider scale implementation have been presented and the results of the domain ''intervention characteristics'' suggest that the VP application is largely ready for implementation. There does not appear to be any need to change the design of the VP on the basis of implementation, but what is currently absent, and needs developing prior to implementation of the VP, is a network of supporting infrastructure to facilitate a successful a wider-scale implementation. This will be further discussed in section 9.4.

Domain	Construct	Construct definition	How is the construct met or not met?
1. Intervention characteristics	a. Intervention source	Perception of key stakeholders about whether the intervention is externally or internally developed.	No participants discussed this. It is not clear if who developed the VP affected use. Participants aware that VP was developed outside of their organisations.
	b. Evidence strength and quality	Stakeholders' perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes.	Not covered by the study.
	c. Relative advantage	Stakeholders' perception of the advantage of implementing the intervention versus an alternative solution.	Advantages of VP vs other options (section 8.2.2).
	d. Adaptability	The degree to which an intervention can be adapted, tailored, refined, or reinvented to meet local needs.	Discussion of how the VP is adaptable to be used in different sectors and setting etc. but not on changing the design of the VP for this purpose.
	e. Trialability	The ability to test the intervention on a small scale in the organisation, and to be able to reverse course (undo implementation) if warranted.	Study has proven ability to test the intervention on the small scale. Ability to reverse implementation not discussed.
	f. Complexity	Perceived difficulty of implementation, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps required to implement.	Some comments on where the VP sits in practice and how it could be incorporated (section 9.2.1). No discussion on the complexity of this or remainder of the construct.
	g. Design quality and packaging	Perceived excellence in how the intervention is bundled, presented, and assembled.	Usability, functionality, user friendliness discussed (section 7.3). Technical quality and maintenance not discussed.
	h. Cost	Costs of the intervention and costs of implementing that intervention including investment, supply, and opportunity.	No discussion of cost. Not covered by the study.
2. Outer setting	a. Patient needs and resources	The extent to which patient needs, as well as barriers and facilitators to meet those needs are accurately known and prioritised by the organisation.	Users aware that this is an area lacking in education and training and how this can affect patients. Limited information on priority.
	b. Cosmopolitanism	The degree to which an organisation is networked with other external organisations.	Not covered by the study.
	c. Peer pressure	Mimetic or competitive pressure to implement an intervention; typically, because most or other key peer or competing organisations have already implemented or in a bid for a competitive edge.	Not covered by the study.
	d. External policy and incentives	A broad construct that includes external strategies to spread interventions including policy and regulations (governmental	Not covered by the study.

		or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting.	
3. Inner setting	a. Structural characteristics	The social architecture, age, maturity, and size of an organisation.	Not covered by the study.
	b. Network and communication	The nature and quality of webs of social networks and the nature and quality of formal and informal communications within an organisation.	Not covered by the study.
	c. Culture	Norms, values, and basic assumptions of a given organisation.	Not covered by the study.
	d. Implementation climate	The absorptive capacity for change, shared receptivity of involved individuals to an intervention and the extent to which use of that intervention will be rewarded, supported, and expected within their organisation.	Wider issues with practice, working pressures and CPD engagement highlighted (section 9.2.1). This may be prohibited and needs considering before implementation.
	- Tension for change	The degree to which stakeholders perceive the current situation as intolerable or needing change.	Identification of some of the reasons why VP would be good – e.g. consequences for the NHS (section 8.2.3) but no information on if organisations think this needs to change
	- Compatibility	The degree of tangible fit between meaning and values attached to the intervention by involved individuals, how those align with individuals' own norms, values, and perceived risks and needs, and how the intervention fits with existing workflows and systems.	Some discussion of how the VP fits with alternative resources and methods (section 8.2.2). This requires further consideration.
	- Priority	Individuals' shared perception of the importance of the implementation within the organisation.	Qualitative results on the importance of NOAC counselling broadly and quantitative results identified some with no previous NOAC counselling (section 6.3). No information about organisation level importance.
	- Incentives and rewards	Extrinsic incentives such as goal-sharing awards, performance reviews, promotions, and raises in salary and less tangible incentives such as increased stature or respect.	Some confusion over who is responsible for NOAC counselling (section 9.2.1) this may be prohibitive in the perceived reward for using the intervention. Further consideration required.
	- Goals and feedback	The degree to which goals are clearly communicated, acted upon, and fed back to staff, alignment of feedback with goals.	Not covered by the study.

	- Learning climate	A climate in which: a) leaders express their own fallibility and need for team members' assistance and input; b) team members feel that they are essential, valued, and knowledgeable partners in the change process; c) individuals feel psychologically safe to try new methods; and d) there is sufficient time and space for reflective thinking and evaluation.	General perspectives on learning climate gathered (section 6.3) and the intervention may offer advantages in user safety. More information is needed on reflective space and time, and how the intervention links with leadership support and guidance.
	e. Readiness for implementation	Tangible and immediate indicators of organisational commitment to its decision to implement an intervention.	Not covered by the study.
	- Leadership engagement	Commitment, involvement, and accountability of leaders and managers with the implementation.	Not covered by the study.
	- Available resources	The level of resources dedicated for implementation and on-going operations including money, training, education, physical space, and time.	Some comments on accessibility (section 7.3.1). No mention of ongoing application management and delivery package for the VP still to be decided.
	- Access to knowledge and information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks.	Some comments on limited information on the 'purpose' of the VP (sections 6.6 and 8.2.2). This needs to be more comprehensive with the VP developers deciding on an implementation strategy.
4. Characteristics of individuals	a. Knowledge and beliefs about the intervention	Individuals' attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention.	Qualitative results on the acceptability of the VP. Some mixed information on who is responsible for NOAC counselling. Some users not aware of truths relating to some of the values of the VP.
	b. Self-efficacy	Individual belief in their own capabilities to execute courses of action to achieve implementation goals.	Not covered by the study.
	c. Individual stage of change	Characterisation of the phase an individual is in, as he or she progresses toward skilled, enthusiastic, and sustained use of the intervention.	Not covered by the study.
	d. Individual identification with organisation	A broad construct related to how individuals perceive the organisation and their relationship and degree of commitment with that organisation.	Did not consider single organisations as part of the study.
	e. Other personal attributes	A broad construct to include other personal traits such as tolerance of ambiguity, intellectual ability, motivation, values, competence, capacity, and learning style.	Results from the study include considerations for personal engagement and learning styles.

5. Process	a. Planning	The degree to which a scheme or method of behaviour and tasks for implementing an intervention are developed in advance and the quality of those schemes or methods.	Not covered by the study.
	b. Engaging	Attracting and involving appropriate individuals in the implementation and use of the intervention through a combined strategy of social marketing, education, role modelling, training, and other similar activities.	Through the research each site implemented the intervention to gain participants, this used varied strategies. Participants also commented on implementation strategies broadly (section 9.2.1). Chosen engagement methods still needs to be finalised and implemented with considerations for single organisations.
	- Opinion leaders	Individuals in an organisation who have formal or informal influence on the attitudes and beliefs of their colleagues with respect to implementing the intervention.	Not covered by the study.
	- Implementation leaders	Individuals from within the organisation who have been formally appointed with responsibility for implementing an intervention as coordinator, project manager, team leader, or another similar role.	Within the study sites individuals to promote participation were identified and utilised. For a larger scale implementation this needs scaling up.
	- Champions	"Individuals who dedicate themselves to supporting, marketing, and 'driving through' an [implementation]", overcoming indifference or resistance that the intervention may provoke in an organisation.	Within the study sites individuals to promote participation were identified and utilised. For a larger scale implementation this needs scaling up.
	- Change agents	Individuals who are affiliated with an outside entity who formally influence or facilitate intervention decisions in a desirable direction.	Not covered by the study.
	c. Executing	Carrying out or accomplishing the implementation according to plan.	The study demonstrated some ability to execute small level implementation, a widescale plan is required before full execution.
	d. Reflecting and evaluating	Quantitative and qualitative feedback about the progress and quality of implementation accompanied with regular personal and team debriefing about progress and experience.	Not covered by the study.

Table 9.1 Consolidated framework for implementation analysis (CFIR) constructs and construct definitions taken from Damschroder et al. (2009)

9.4 Discussion

Building on the discussions within chapters 7 and 8, the VP was largely considered acceptable by the participants although from these results it became apparent that wider elements of pharmacy practice may impact the potential usability of the VP in practice. The VP is not an isolated opportunity and so must be usable within the constraints of practice.

There were concerns regarding the time users would get in practice to use the VP. This is an increasingly common concern in pharmacy practice with recognised incidences of working pressures being prohibitive of other duties, including education (Resnik *et al.* 2000). This appeared to be a problem far wider than the VP evaluation but nonetheless for some users this was a limiting factor in its usability. Another significant discussion area was the use of the VP across different sectors. For most users the community nature of the VP setting was acceptable, and they could appreciate the transferable nature of the application content, but for others this distracted from its usability. As highlighted in the systematic review (section 3.5.2) and is further discussed in section 10.5, the majority of other VP applications have been highly specific to single organisations and universities and thus transferability is not something which has been evaluated in detail.

Within the discussion of pharmacy sectors, there was some wider debate around whose role in practice NOAC counselling is. For some participants they did not see the counselling as part of a particular role, and this limited its acceptability although this did seem to be due to wider perspectives on NOAC counselling rather than due to the VP. This contrasts with the literature discussed in section 1.2.2 from the ESC who stated that anticoagulant counselling is the responsibility of all HCPs, including pharmacists (Heidbuchel *et al.* 2015). This disputes any suggestion that those working in a particular sector or role are 'responsible' for NOAC counselling.

Considering CPD, there were some negative comments and perceptions of CPD generally and this could limit the VP's acceptability for CPD. This was not the case for the majority of participants who did find the VP acceptable for CPD purposes; no participants commented that the VP was completely unsuitable for this purpose, but this is not without disagreement. Some users commented that they were unsure how exactly the VP could be implemented and would be used practically for CPD. If the VP is to be used for this purposes then the VP developers should consider altering the VP to better align with CPD requirements as set by the GPhC (General Pharmaceutical Council 2018a). Any change in the targeting of the VP for CPD, should be carefully considered as not to limit the potential uses of the VP and to solely restrict VP use to CPD purposes as uses outside CPD were reported (section 8.2.2).

As for CPD there was a lot of discussion around different users of the VP and possible changes based on the audience. Most participants could see uses for multiple user groups, although a particular group may have been favoured by the individual. As discussed in section 9.2.2, pre-registration trainees and newly qualified pharmacists appeared to be the favoured groups to use the VP. Pharmacy technicians were also strongly favoured, and this contrasted with specialist and longer qualified pharmacists where perspectives were wider ranging. Similar to CPD, any changes to the VP based on the target audience should not limit use to single groups as the broad nature of the VP appears to currently be an advantage. One possibility is the way in which the VP is presented to different groups could be improved to meet these suggestions. This could possibly be done without changing the content of the VP application specifically; this links with an implementation strategy which is discussed later in this section. In the future, one group that it appears could particularly benefit from VP use is that of pharmacy technicians, particularly as they are underprovided for educationally (Schafheutle *et al.* 2017). This is a suggested area for future VP development (section 10.5.1).

Engagement also needs to be considered when implementing the VP for CPD purposes as mandatory training and CPD have been reported to have a lack of engagement from users particularly due to time commitments and their mandatory status (Laaksonen *et al.* 2009). Until employers and/or the regulator move to focus on allowing pharmacists the opportunity to undertake education and training this is likely to be a continuing when evaluating educational tools. In the meantime developers could look to optimise the time requirements of their tools without compromising on educational value. Additionally, across the user groups it was suggested that the consequences of conducting this learning may also have different consequences for different types of users and thus this may affect engagement. This concept is evidenced in the literature when Thompson *et al.* (2017) discussed that their participants, pre-registrations trainees, were significantly concerned with learning associated with the registration assessment. On this basis, the consequences of the learning for the different user groups should be considered in implementation. This also meets some of the requirements for the CFIR construct ''implementation climate'' whereby the priority and incentives for use of the intervention are considered.

Across the participants it was clear that many found the VP useful as an intermediate between knowledge-based aspects of NOAC counselling and using the learning in practice with real patients, this has already been discussed in section 8.2.2. Despite this, it was highlighted that for some users the VP had the potential to nurture bad practice and this reduced its acceptability. Within the literature there does not appear to be any examples of learnt 'bad' practice from using VPs, but somewhat surprisingly it has been recognised that experiential learning cycles within practice alone could reinforce and perpetuate bad practice picked up from peers (Stevens *et al.* 2006). This directly conflicts with the reported perspective of the participant previously discussed. It is not clear if there is a risk of nurturing of 'bad practice' from VP use. Furthermore VPs are recognised to be useful to standardise learning so this is unlikely (Hege *et al.* 2016). If the learning from using the VP would otherwise take place in

practice and could result in variable learning, it is possible that VPs could actually reduce the level of 'bad learning' where the learning would normally be conducted on a variable peer-to-peer basis.

Regarding the implementation analysis, no issues with the VP content were identified which would limit implementation, but the supporting infrastructure of the VP needs development to prepare for implementation in order to fully implement the VP and meet the domains of the CFIR. The CFIR analysis could be repeated prior to wider implementation to identify that the support needed for an efficient implementation is in place. Participant perspectives on the proposed implementation would also be useful to better develop this. VP infrastructure includes an implementation strategy, organisation-level support and identification of individuals to help implement the VP. This is supported by the work of Moullin *et al.,* who said that implementation should include implementation indicators to help measure the progress and success of implementation (Moullin *et al.* 2016). The implementation strategy should help to target implementation and ensure that the VP is being used as part of quality education and training. There does not appear to have been any research conducted into the wide scale implementation of VPs, this would help contribute to the literature-base on VP use in practice.

No other VPs appear to have been externally developed but rather, in the majority developed by universities. As this VP was commissioned externally, this is an additional factor that could potentially impact implementation and will need to be considered as perception of who has developed an intervention can effect implementation and uptake (Damschroder *et al.* 2009). Equally, this would need to incorporate considering the influence of cost on implementation. Moreover, areas such as the packaging and maintenance of the VP need to be considered. These concepts were discussed in the work by Hege *et al.* (2016) who's framework for VP design was presented in section 2.3.1. Hege *et al.* (2016) recognised that VPs have a level of cost associated with not only the development of VPs but also their maintenance and ongoing

support. This is similar to the work of Tan *et al.* (2010), as discussed in section 2.3 who stated that as VPs are a rapidly evolving technology they require a level of constant maintenance.

A number of roles and responsibilities are presented by the CFIR to help with a successful implementation. The VP was not at the stage of recruiting these individuals during the evaluation although the framework provides a useful list of roles to use as a starting point for future implementation. Despite this, the study took place across 14 sites and some sites only had a single participant therefore further work is required around engaging with wider groups of users at each site. This demonstrates that some of the elements for a wider scale implementation have been considered but this needs more comprehensive development prior to any wider scale implementation. An implementation strategy could incorporate organisational level aspects, identification and training of key stakeholders in the implementation process, and some of the broader areas covered by the CFIR to facilitate a successful, wider-scale implementation.

The majority of participants were positive towards the incorporation of the VP into practice, but a significant proportion were more pragmatic and cautious regarding the practicalities of implementation. Despite this, it appears that the VP users recognised the CPD opportunity, with one participant stating that they had already used the VP for this purpose. Overall, the VP was largely acceptable and useful, but some areas of everyday pharmacy practice could limit use for some individuals.

9.5 Summary

This chapter has presented and discussed the final group of themes relating to the interview analysis. Following this, an implementation analysis was undertaken using the CFIR, this discussed the study results relative to an implementation framework. The next chapter will collectively consider the results and discussions of the two phases together to give an overall interpretation of the results and discuss the importance of the findings for others.

10 Discussion

10.1 Introduction

This chapter follows on from the presentation of the results of the study to discuss the relevance and implications of the findings in the context of wider literature on VPs. The findings will be related to wider pharmacy practice to highlight their significance.

10.2 Key results

The results of the evaluation have been discussed in sections 6.10, 7.4, 8.3 and 9.4. The key findings of this evaluation are as follows:

- The majority of users appeared to like the concept and delivery of the VP, although there were a few technical issues which need investigation before any further implementation.
- Benefits to the users appeared to range widely but included: combinations of changes in knowledge and confidence, including contextualisation of learning to a patient interaction; an opportunity to practice; and, reflective opportunities. These benefits map to Kolb's theory of experiential learning, this will be further discussed in section 10.3.3.
- A statistically significant average improvement in self-reported counselling ability was demonstrated pre- to post-VP use (average improvement of 10.2%, -30.3%-39.6%). This average improvement in ability could incorporate a number of types of learning as discussed previously, such as knowledge and confidence changes.
- The VP has demonstrated its use by a range of pharmacists and pre-registration trainees although it may be of more use to pre-registration trainees or newly qualified pharmacists to help transition knowledge to practice by providing contextualised and experiential learning (section 8.2.2). Use of the VP by pharmacy technicians was suggested although this is speculative by the participants and no pharmacy technicians have trialled the VP.

- Elements that need consideration prior to implementation of the VP have been highlighted, such as the way in which feedback is delivered, particularly around the use of the colour coding and also the restrictive nature of the MCQs (sections 6.5 and 8.2.2). An implementation strategy is required to ensure that when the VP is implemented it is done so with the infrastructure in place to support its use.

This evaluation is the first to provide insights into the use of a VP by qualified pharmacists and further contributes to the literature on the use of VPs by pre-registration trainees. This evaluation has further demonstrated a number of advantages to VP use that have been reported in literature previously. Two examples being that the VP provides a safe environment and also an opportunity to practice (section 8.2.2). This directly contributes to the literature base for VP use. This evaluation appears to be the first to consider implementation into practice and provides insight into the areas of VP infrastructure that need addressing for a successful implementation (section 9.4). Furthermore, the evaluation has, in some detail, shown insights into the relationship between the VP and how it can be used in practice. This has identified some barriers which may limit the use of the VP in day to day practice which is a more realistic view of the synergistic relationship between the VP application and practice rather than considering VP use in isolation (section 8.3).

10.2.1 Summary of data triangulation and integration of the results

As stated in section 4.4.5, the results of the two sequential phases were integrated to give an overall interpretation of the findings. Throughout the discussions of this chapter, data from across the study have been considered together; some key areas and discussions are highlighted and discussed below.

The first approach to integration was that the data from phase one of the study directly informed the questions and discussions of the interviews as a way of further exploring

perspectives and of corroborating the initial data. The areas which this applied to are largely discussed in section 5.5.1.

The questionnaire findings gave an overview of perspectives on the VP with a number of areas identified from the results as requiring further investigation (section 6.11.2). This included that the questionnaire results concerning feedback showed mixed results. When this issue was explored within the interview phase it emerged that the aspect of the feedback which the participants did not favour was the use of the colour coding to categories feedback as 'good' and 'bad' and this limited the acceptability of the application (section 8.2.2).

Similarly, within the questionnaire, the VP technology was cited to be less favourable by some respondents. This was an unexpected finding as the VP technology uses current high-quality animations and designs, additionally the pilot study suggested that it was functionable. When this unexpected finding was explored in the interviews it emerged that the technology as a whole was not the problem, but rather it was the slow speed of the animations experienced by some users (section 7.3.1). The qualitative phase allowed for this greater depth of insight and the initial unexpected finding was explained by being able to pinpoint the exact issue.

Furthermore, some of the areas identified from the questionnaire results as the 'best' things about the VP were also highly discussed as 'worst' areas as part of the questionnaire (section 0). This initially appeared to be a somewhat contradictory finding but, after the interviews, which were designed to directly address some of these areas, this became clearer. One key area was the MCQs within the application not being well liked. It emerged from the interviews that it was not the question style which was disliked, but rather the restrictive nature of it and the underlying algorithmic design of the VP. Similarly, within the questionnaire results the realism of the VP was reported to be fairly well liked but the VP not being reflective of practice was one of the least favoured concepts. This juxtaposition became clearer following the interviews where two types of realism were identified: technological and pharmacy practice

based. Using this classification, technical refers to realism of the animations and of the application to simulate a real environment whereas practice-based refers to the realism of the application to day to day pharmacy practice and the realism of the clinical content of the application. Using this concept of different types of realism, it is possible that in the questionnaire the respondents thought that the VP technology was realistic in that it looked and acted realistically but some of the content was not reflective of what happens in practice clinically. This is also an example of using data integration to provide real life contextualised findings that consider pharmacy practice.

The second element of integration involved comparing the two complete data sets to identify similarities and differences between to the two to corroborate the findings. The two phases of the study largely agreed with each other and the benefit of the adopted methods, as discussed in section 4.4.5, were that results could be explored in greater detail and corroborated to provide a holistic and contextualised overview of the results.

The questionnaire results demonstrated that on average user's self-reported an improvement in their ability to conduct NOAC counselling (section 6.4). This was further explored in the interviews where a number of different types of learning were identified and a greater depth of insight was possible. This resulted in the realisation that VP use can provide an opportunity to practice safely and can result in a number of outcomes such as refreshment of knowledge. This is also true of the question concerning repeated use of the VP where the questionnaire responses largely agreed with the interview discussions in that most users would use the VP more than once. Despite this, as part of the interviews a further level of insight was possible whereby it was established exactly what repeated use might look like in practice. This included the possibility of an initial 'in depth' use of the VP followed by repeated use although in less detail (section 8.2.2).

There were some lesser reported uses of the VP, such as one participant who stated that they used the VP a second time only to get all 'green' feedback. This closely links to the other results regarding the feedback, particularly that the colour coded feedback was not well liked (Figure ***1.8***) (sections 6.5 and 8.2.2). The identification of a minority use of the VP in this way will be useful for VP developers to appreciate the unanticipated decisions of users and to better design VPs moving forward.

As the interviews were socially contingent, the interview results have provided vital context and individual perspective on the questionnaire satisfaction and usability results. This allowed confirmation that the majority of experiences matched with those reported across chapter 6 from the questionnaire results.

10.3 Significance of the key results

10.3.1 Pharmacist's and pre-registration trainee's satisfaction in usability

Overall the VP had largely positive reports of user satisfaction and this resulted in a level of acceptability by the participants, although some improvements have been identified to optimise this (section 7.4). From a technological point of view the VP was functional and this appeared to contribute to its usability. In previous VP studies, technology was found to have significant limitations to its uses (Stevens *et al.* 2006, Botezatu *et al.* 2010, Douglass *et al.* 2013) but, this study has demonstrated an application which is largely accepted by the users. Some limitations of the technology were highlighted although in most cases the participants accepted these and they did not limit use; these are further discussed in section 10.4.2.

As stated in section 1.4.3, the five questions posed by Sharples *et al.* (2005) considering mobile learning were considered and the results of the study have demonstrated that the VP meets these as follows. The VP is significantly different from other methods of teaching used in its field especially for teaching a user how to conduct patient counselling (sections 0 and 8.2.2).

The VP provides mobility for users as it can be used anywhere, at any time and on any number of devices with an internet connection; this was favoured by the respondents who used this feature. The VP also covers both informal and formal learning as it can be used for CPD meeting formal requirements and also informal learning outside of CPD. The learning resulting from VP use appears to be constructive, especially as a number of participants directly commented upon the constructive nature of the feedback (section 8.2.2). This could be improved by changes to the delivery of feedback such as rethinking the colour-based design.

Finally, the VP learning is personal yet mediated by technology, as the learning is part of a cycle which incorporates taking the learning out into practice, supplementary to other methods and experiences in practice. A number of participants discussed the ways that the learning has impacted their practice. This is also in line with the work by Georg and Zary (2014), who stated that VPs are not merely objects but learning activities. This evaluation has demonstrated this but has taken this further to also incorporate daily pharmacy practice and cycles of learning, in line with Sharples *et al.* (2009) who said that mobile learning should extend ‘’*into the conversations and interactions of everyday life*’’.

The VP questioning method was one area that was highlighted by almost every participant particularly as it has been described as ‘restrictive’ (sections 6.5 and 8.2.1). Despite this, participants appeared to not want the questioning method changing to an alternative method but rather the questioning method optimised possibly through some level of free text or extended option questions. Although this may increase the flexibility to the user and better improve usability and user experience, there may need to be a level of compromise with regards to the technical abilities of the application and the complexity of programming. Not changing the question style completely is also in line with the work by Bearman *et al*., who discussed that multiple-choice questioning is recognised to be suited to narrative VPs (Bearman *et al.* 2001).

Within the results of this evaluation, realism was a reoccurring topic that spanned many of the themes and results. Realism refers to the ability of the application to recreate a life-like scenario and it is closely linked with ideas of authenticity (Hege *et al.* 2016). Considering the current literature base for VPs, this study approached the concept of realism from somewhat of a different perspective; this has already been briefly presented in section 10.2.1. Following mixed questionnaire results on realism (section 6.5.2) rather than broadly considering realism the authors tried to consider what realism consisted of and two main areas were identified: realism of the technology (section 7.3.2) and realism compared to pharmacy practice (section 8.2.1). This breaking down of realism appears to be novel within the literature despite realism being recognised to incorporate distinct ideas as previously been discussed in the systematic review (section 3.4.3).

This multi-faceted concept of realism was illustrated with Henry as the patient. He was recognised to look, react and function largely like a person, albeit within the constraints of the technology (section 7.3.2). But there were some concerns as to whether Henry was representative of patients with AF and taking NOACs due to his medication history (section 8.2.1). These concerns largely related to clinical details which some participants did not think were likely to be representative of real patients. Rather than grouping this into broad realism a deeper level of insight was established and thus more targeted areas for optimisation were identified.

Bateman *et al.* (2013), described a 'trade off' between learning quality and realism whereby a VP cannot be completely realistic as this would conflict with the learning experience and ultimately a compromise between realism and learning is required. Although different types of realism were not explicitly referred to, and no other literature appears to have done this, Bateman *et al.* (2013), recognised that complete realism may be unattainable for an educational tool. This is because complete realism would provide an inferior learning

opportunity as the focused would be on realism rather than the learning within the application design. Within the results of this study, it appears that the realism of the technology is largely good and well-liked, but clinical realism may still need developing prior to reaching the 'optimum' realism. Any developments to the clinical realism should be done without losing educational value as discussed by Bateman *et al.* (2013). Although technically this may not be possible, and a level of compromise may be required between the realism to clinical practice and technical usability.

10.3.2 The ability and usefulness of the VP to teach NOAC counselling

The findings of this study demonstrate that the VP can be a valuable tool in teaching how to conduct NOAC counselling with patients. This value manifests in different ways with various possible benefits to using the VP. This value is in line with findings of other pharmacy VP evaluations (Fleming *et al.* 2009, Thompson *et al.* 2016b, Zlotos *et al.* 2016) but goes further to detail the different types of learning that users may experience. As discussed in the narrative systematic review (chapter 3), VP use in pharmacy students already has a significant literature base with demonstrated benefits. Not only has this evaluation demonstrated benefit in in a new audience, qualified pharmacists, and further added to evidence around pre-registration trainee VP use, it has also provided insight into user perspectives, how the VP is used educationally, and how this can relate to practice and experiences as part of a learning cycle.

As discussed in section 8.2.2, there was a range of ways that users used the VP, particularly around the frequency of use. One participant discussed using the VP to get perfect feedback. This individual only appeared to be bothered about getting the 'right' answer without necessarily learning or understanding why this was the case. This, as already discussed, could be an example of surface learning possibly due to gamification of the learning. Gamification refers to *"the use of game design elements in nongame contexts"* (Deterding *et al.* 2011). This is an emerging but recognised concept in educational research, particularly around the use of

technology (McCoy *et al.* 2016). When developing an application with some game principles a balance is needed particularly if reflection is an aim of the application (Nicholson 2015). Nicholson (2015), discussed that applications based on Kolb's theory of experiential learning may lose some of their value if there is too greater emphasis of game principles. This occurs when the emphasise on game principles removes the opportunity and time to reflect and consider the learning in a deep way as the user is pushed to the next task or level. In this evaluation the majority of users did not appear to try to 'play' the VP for perfect feedback and get drawn into the VP's gamified features, but more commonly a deeper learning including reflection and linking learning to practice was reported. This could suggest that the balance of gamification is appropriate, but as demonstrated by the single participant the balance between game and educational application needs to be carefully considered.

The VP appeared to have some sort of benefit to all of the participants albeit varied, even those which reported a negative change in their ability pre- to post-VP were positive towards the VP and its uses (section 6.10). It is stated that branched or narrative VPs, such as this one, are suited to encourage reflection-based learning to teach communication skills because of the 'stronger sense of the real patient' (Bearman *et al.* 2001). A significant proportion of the participants appeared to use the VP in this way but also as a more overt practice opportunity to help to develop confidence in NOAC counselling (sections 6.6 and 8.2.2). This does not entirely align with the work by Bearman *et al*. and perhaps highlights the range in which VPs may be useful and also that the VP is an individualised learning tool. Despite the VP design not always aligning with the concepts described by Bearman *et al*., another of the demonstrated benefits of allowing for mistakes in a safe environment is in line with the work by Bracegirdle and Chapman (2010), who explained that VP use can make users appreciate the consequences of mistakes. This is a well discussed advantage of VPs (section 2.4.4) (Cook and Triola 2009, Bindoff *et al.* 2014, Georg and Zary 2014).

10.3.3 Incorporation of the VP into education, training and CPD

The VP appears to be largely suitable for incorporation into the education and training of a number of types of pharmacy professional, particularly pre-registration trainees and newly qualified pharmacists and in both hospital and community sectors (section 9.2.1), although how exactly this should be done needs consideration. The VP has demonstrated possible wider benefits, particularly to the NHS (section 8.2.3) over more labour-intensive educational alternatives. Its unique contextualisation of learning in a patient-facing way appears to be favoured by users compared to more subjective alternatives such as role play, and other more knowledge-based alternatives (section 8.2.2). Additionally, the specifics of CPD requirements such as the information required by the GPhC and how this information can be mapped to VP use need to be considered in order to make it easy for users to use the learning as evidence of CPD.

Furthermore, from an educational perspective, use of the VP maps directly to the experiential learning cycle as presented by Poore *et al.* (2014) (section 1.4.2). But what seems clear from the results is that the participants were not always appreciative of how exactly the VP facilitates learning. Regardless of this, the users often discussed reflection and refreshment which both sit well within the experiential cycle particularly the phase where mental models of tasks are redefined and refined (Zigmont *et al.* 2011) (Figure ***1.2***) The VP could sit as part of the concrete experience or also as the active experimentation depending on how the user uses the VP and their opportunities for active experimentation in practice. As the majority of users would use the VP repeatedly this suggests some identification of a cyclical process.

Bloom's Taxonomy is an educational classification model of skill development which is of relevance to the VP. This taxonomy has been selected as it is one of the most well used frameworks and it has established use for pharmacy-based training and thus the taxonomy fitted well when thinking about the educational outcomes of using the VP (CPPE 2018). The

taxonomy uses six classifications for the different processes which are included in learning objectives (Anderson *et al.* 2001). In this case, the VP appears to encourage learning of the higher orders particularly analysing and evaluating. This links closely with the experiential cycle as depending on where someone is within the cycle they may be learning at a different level of Bloom's taxonomy. The VP appears to encourage users to move through the experiential cycle and work at higher levels of Bloom's taxonomy but, in order to do this the application should be implemented around other education and training, and CPD with considerations for pharmacy practice and curriculum integration.

Duff *et al.* (2016) supported consideration for the incorporation of VPs into a curriculum as timing and placement may impact user experience. Some of the participants of this study expressed concerns about where exactly VP use could be incorporated into practice. This, therefore, provides an example of the users themselves being aware of the importance of curriculum integration as discussed by Duff *et al.* (2016). Throughout this study, the VP has not been considered as an isolated learning tool and in a similar way this should be the case in practice. The VP can be used alongside other educational tools and methods as part of the experiential cycle depending on an individual's requirements, this is in line with Sharples *et al.* (2005) as discussed in section 1.4.3 who suggested mobile resources be used alongside other 'traditional' resources and methods . For example, a user may choose to use the tool first, as part of concrete experience, followed by role play and then real consultations as active experimentation or alternatively knowledge-based learning such as CPPE first followed by the VP as part of active experimentation. Ultimately, the way in which the VP can be used can be tailored to an individual, the stage they are at in the experiential cycle, and the other forms of experiential learning available to them.

Considering longer term use of the VP, a small number of VP studies have considered longer term outcomes of competence, although these are in the minority (Bindoff *et al.* 2014, Zlotos *et al.* 2016). This study did not overtly address long term outcomes, but some perspectives on

how the VP was used were gathered specifically around repeated use of the VP and how it could be used within pharmacy practice. The study by Zlotos *et al.* (2016) stated that findings six months after VP use were confounded due to the participants also working in practice during this time. If this was to be considered with regards to the VP under investigation in this study an evaluation of long-term outcomes would need to consider that the VP may be used repeatedly, alongside other resources and experiences in practice as part of an experiential learning cycle. Thus, any evaluation of behaviour change or longer-term outcomes would need to be multi-faceted and consider that VP use is not an isolated opportunity. This evaluation appears to be the first VP study to place an emphasis of the results for use in practice, in line with the methodology of the study. Furthermore, the finding that participants often repeatedly used the VP (section 8.2.2) is useful for an implementation strategy as information regarding exactly how users are likely to use the VP will contribute to establishing its use in practice and getting the support of organisations to implement the VP.

The discussion in section 9.2.2 on different VP audiences and that the VP may be particularly useful to pre-registration trainees and newly qualified pharmacist, is supported by Duff *et al.* (2016) who discussed that VP use is better in the earlier stages of training, although this was based on the medical profession and with limited evidence from robust studies. This study shows that the audiences which were most often favoured were those with less experience such as pre-registration trainees and newly qualified pharmacists. Through the use of multiple and varied participants groups within this study, this meets a suggestion by Jabbur-Lopes *et al.* (2012) for research using wider populations to better contribute to the validation of VP use. This could be taken further by incorporating other forms of pharmacy professional such as pharmacy technicians.

10.3.4 Improvements and next steps for the VP

On the basis of the findings of this evaluation as summarised in section 10.2, a number of improvements to the VP have been identified. It should first be highlighted that, despite a range of recommended changes or developments to the VP application, these should only be made when appropriate considering the technological capabilities of the VP. VP applications are a complex web of algorithms and pathways and even the smallest changes can have effects on usability and experience (Bracegirdle and Chapman 2010). Therefore, any changes should be made with careful consideration for a balance between technology, educational principles and user experience as the three are closely linked (Huwendiek *et al.* 2009). In reality this may not be completely possible, and a level of compromise may be required, this is articulated the in the following sections.

Technology and design

The majority of technological recommendations are minor as the VP has demonstrated usability but there are a number of recommendations to hopefully optimise VP use. Firstly, the programming of the VP should be tested and any issues rectified after a number of users reported the application freezing or not loading (section 7.3.1). Although it is more likely, that this was due to the computers and devices being used rather than the application. The significance of poorly functioning technology emerged as a key area within the systematic review (section 3.4.3) and thus this should be improved as far as possible although there may always be a level of technical limitation as was discussed in section 10.4.2.

A more significant technological and design change that should be considered is the possibility of a 'back' button (section 7.3.1), but this may not be in keeping with the exploratory educational purposes of the VP and that experiencing mistakes is a useful learning opportunity and an advantage of the VP (section 8.3). Equally, the developers may have alterative ideas on

how to improve navigation within the application without including a back button. This may overcome any associated potential negative consequences of a back button whereby users could use the button to go back when they realise they have selected a less than optimal response rather than to navigate around the application or to un do genuine errors (section 7.4). Bateman *et al.* (2013) and Hege *et al.* (2016) explored the concept that navigation is a variable in VP design that should be considered in as much depth as other variables would be, with the latter study stating that navigation impacts the level of standardisation for the user; although there is little evidence of how this translates to the design and functionality of VPs.

Another recommendation for consideration concerns the style of questions within the application. There were a range of perspectives on the use of the MCQs and the possibility of other types of questioning such as free-text questioning. This should be reviewed in line with the educational recommendations below and also potential future VP applications. It is possible that a range of applications increasing in complexity and with different questioning styles could be used, this links to the concept of a VP library as is discussed below under *implementation*. This needs to be carefully considered also thinking about who the audience of the VP is likely to be.

A clearer recommended change is that the feedback design should be reviewed, the use of the colour coding for delivering feedback as visualised in Figure ***1.8*** was not favoured due to the perspective that 'red' feedback should not be 'red', therefore this should be changed (section 8.3). One option being that the red coding should only be used for obviously unsafe or incorrect feedback and possibly an amber coding for areas for improvement which are not as clear and obvious. Alternatively, a complete removal of colour coding is another possibility; any change would need to be evaluated. This is in line with Guise, Chambers, and Valimaki (2012) and Hege *et al.* (2016) who discussed the importance of feedback as a design element of VPs and also Zigmont *et al.* (2011) and Poore *et al.* (2014) where the importance of effective feedback was discussed relative to the experiential learning cycle.

Education

A number of educational elements have been highlighted for improvement and development. This starts with a recommendation that there should be clarity regarding why users are using the VP and what they can expect to get out of it, this should emphasise that is not a purely knowledge-based learning experience and should encourage reflective thinking and experiential learning. This should be carefully incorporated as not to stem individualism outside of this, one method could be to make this clearer in the case introduction (Figure ***1.6***) or to include this in the implementation strategy when the application is promoted and circulated to potential users.

Additionally, it should be emphasised to users prior to VP use that the VP should encourage exploratory use of the application and not focus on 'right' and 'wrong' answers, this should encourage further experiential learning. As discussed in section 2.4.2, a VP nursing study reported that VP users moved through Kolb's experiential cycle and became more aware of the process (Forsberg *et al.* 2016). This suggests that users can be made aware of the cycle and that this may aid their learning.

Implementation

As discussed in section 9.2.2 a range of types of user could benefit from use of this VP and also of wider VP use. It would not be beneficial to stifle this range of user but, within implementation it may be worth targeting the VP at particular audiences to maximise beneficial use. The range of user that the VP appeals to appears to be one of its advantages and this should remain, but the practicalities of implementation may require a somewhat of a more targeted approach such as by targeting individuals newer to counselling.

The implementation analysis (section 9.3) demonstrated that the VP still needs large areas of development prior to any wider implementation. This is particularly true for the outer setting

constructs which largely relate to organisational level issues; the intervention itself is largely ready for implementation. Process constructs also need improvement and there should be named individuals within an organisation to support the implementation process. As discussed in section 5.6, few previous studies have considered implementation of VPs wider than individual organisations and none appear to have done this rigorously through using an implementation framework. If this is therefore further considered this would be a significant contribution to the field of VP research.

Further VPs

The developers of the VP could consider developing a library of VP applications. This could incorporate both other NOAC based applications with a range of patients and scenarios, and also applications outside of NOACs. This is not the first time a VP library has been considered, Zary *et al.* (2006) suggested the potential for a template library which designers could use as the basis for further VP development; this does not appear to have yet been developed.

10.4 Strengths and limitations of the research

The strengths and limitations of this study will be discussed in this section generally as will the strengths and limitations of the interview phase specifically. The strengths and limitations of the questionnaire phase have already been discussed (section 6.11.1). Reflexivity relative to the strengths and limitations of the study are discussed in section 10.6.

This piece of research is the first to incorporate qualified pharmacists as VP users, something which as previously been identified as needed by numerous studies (Bracegirdle and Chapman 2010, Kane-Gill and Smithburger 2011, Duff *et al.* 2016, Thompson *et al.* 2017). This novelty has proven to be useful as the perspectives of pharmacists have been explored for the first time and the findings add considerably to the literature. The use of mixed methods to explore the depth and range of perspectives on the VP also contributed to the originality of the

research as few VP studies have used qualitative methods and gained individual user perspectives. This strength of the research is due to the adopted pragmatic approach to the evaluation which allowed for a focus on contextualised findings relevant for practice. A particular strength to note is that the adopted methods allowed for the exploration of questionnaire findings and unexpected perspectives in greater detail to give a better overview of VP use. Further to this, the participant group was from a mixture of secondary and primary care sites from across England and therefore has applicability to many types of reader and this adds to the usability of the findings. The demographics of the participants were also wide ranging with many different experiences and roles which further contributed to the likely transferability of the findings.

There was a risk of self-selection bias from the participants as participation in the study was voluntary and so those that took part may have been more engaged with education and training (Collier and Mahoney 1996). Despite this, there should have still been a range of perspectives on the VP. Furthermore, via the process of data saturation, any perspectives obvious to the researchers which were absent could be addressed and the research would not have ceased until the process of saturation was complete as discussed in section 5.5.4.

These limitations were somewhat countered by the strength that this research has attempted to adopt the strategy of detailing study methods enough so that a reader can judge if the results are applicable to their own contexts (Mays and Pope 2000). It is hoped that a reader is able to judge the applicability of the study and the findings to their own area of practice and the application of VPs.

The study is unable to conclude any long-term effects of VP use on practice. Some information on the short-term consequences, between questionnaire completion and interview, have been identified such as some users using what they had learnt from using the VP in practice. It could

be argued that this in itself is a strength of the research as no previous studies clearly identified uses of VPs in this way.

10.4.1 Interviews

The interview phase of the study had a number of characteristics reflective of a rigorous qualitative study particularly the transparency of the design and of the conduct of the study so that readers can judge if the findings are applicable to their own areas of practice (Braun and Clarke 2013).

The interview guide was developed based on literature and the pilot findings, but also due to the interviews being the second phase of the research, the guide was adapted based on the questionnaire responses. This allowed unexpected results from the questionnaire to be explored further thus contributing to the study quality.

Additionally, the design of the study meant that the second, interview phase acted in part like a follow-up to the questionnaire. This allowed the participants to reflect on their initial perspectives towards the VP and potentially see the consequences for it in practice such as participant 83 who had actually used the VP for CPD purposes (section 9.2.1). This contributed to the depth of qualitative results and the realism of the perspectives reported.

As discussed in section 6.2, there were less respondents from the community sector than the hospital in the interview phase of the study. The respondents were in the same proportions as the first phase of the study and as for the first phase there appeared to be little difference in the results split by sector. In order to maximise recruitment incentives such as the interview taking place at a convenient hour and location including out of hours and over the phone were offered. Considering the analysis of the data collected, it appears as if data saturation was sufficiently reached (section 5.5.4) and thus the recruitment was not a problem as far as to affect results. Furthermore, many of the participants had experiences of working across

sectors or were able to comment on other areas of pharmacy practice and sector. This added to the range of perspectives reported.

Finally, the interview analysis used the Framework approach (section 5.5.3) and the analysis and identification of themes was detailed and prolonged. The themes went through several iterations each time developing and progressing data analysis. Throughout this processes the themes moved from being descriptions of discussion or 'features' to true themes which tell the reader meaningful things about the data (Braun and Clarke 2006). This is considered a strength of the conduct of the interviews.

10.4.2 Limitations of the VP technology and application

During the course of this study a number of limitations of the current VP application have been identified. These have been discussed across the thesis where relevant but the key, limitations relative to the findings and implications of the results are highlighted below.

Technical

A small number of participants reported elements of technical limitations as discussed in section 7.3.1. Although these results were in the minority, they did reveal a limitation of the technology. As the VP relies on an individual user's internet connection, any weak or ineffectual connection may negatively impact user experience of the VP. The VP development team maintained the VP functionality throughout the study and thus the reports of failing connections or trouble loading the VP are more than likely to be due to the user's internet connection or device. As discussed in the systematic narrative review (section 3.5), multiple studies have previously considered the accessibility of VPs in terms of functionality and navigation such as through using common web browsers but none appear to have considered this from a connectivity perspective.

Design

A number of design limitations to the application have been identified and these largely have been discussed elsewhere; a number of these which are more inherent limitations to the VP are discussed here.

As discussed in section 8.3, VPs which use an MCQ design will all have limitations around user restriction as they have inherently been designed this way. This has repercussions for the potential for the VP to achieve 'maximum realism', if such a thing is possible. VPs, when being designed, need to consider the three factors described by Huwendiek *et al.* (2009) of technology, educational principles and user experience.

Similarly, there are limitations on a user level as the application cannot account for individual approaches to consultations. This appeared to be particularly problematic for those longer qualified with more established methods of conducting consultations. This closely links to the discussions of the 'ideal' VP user (section 9.2.2) and it could be posed that limitations of the technology which cannot be overcome with current technical abilities could impact the way in which a VP is designed and implemented. In this example, as the VP is somewhat restricted, particularly for users with more established consultation skills, this could be positioned not as a limitation but rather a strength which can be utilised by targeting the VP not at those with established consultation styles but at those new to consultation skills, this could be done via an implementation strategy. In this way the limitations of the technology can be managed in such a way in which that they become useful.

A further limitation of the technology design is that a number of users reported that it 'felt algorithmic' (sections 0 and 7.3.2). This is somewhat of an inherent limitation of the technology as it runs based on a decision tree using an algorithmic design (section 1.5.5). As emerging technologies become more mainstream, such as artificial intelligence-based

methods, this may provide an alternative which may alter the limitations of VPs, by moving away from algorithmic elements.

Other

One question which largely remains unanswered concerning this VP application is the costs of building, maintaining and proving access to it. Although elements of this have been considered in the context of implementation (sections 9.4 and 10.5) this was not an aim of this research. Despite this, this remains an unanswered question and a possible limitation of the technology if application costs are deemed too great. As discussed in the overview of VPs (section 2.3), costs are broadly seen as a potential limitation of all VPs although this appears to be yet to be determined in a research study.

Similarly, VP applications remain largely individual applications which are highly specific to one case and or organisation, this is further discussed in section 10.5. This remains a limitation of VPs broadly and links closely with cost. It may be that until a 'VP library' is created or there is collaborative working with a national organisation to maintain and develop a collection of standardised VPs then this limitation will remain.

10.5 Implications of this research

The VP can be considered useful for learning in a safe environment. This is something that is well discussed in the literature in the context of VPs for pharmacy students (Zary *et al.* 2006, Zlotos *et al.* 2016) but this is the first time it has been demonstrated in qualified pharmacists. This is particularly relevant as it was pharmacists working in practice who considered the use of the VP as synergistic to their practise rather than in isolation or relative to a university course (section 8.2.2). Further implications for individual users which go past previous research include that the VP is perceived as largely realistic given the constraints of the technology. This is a new concept as most previous studies focused on measuring outcomes

such as knowledge rather than user perspectives and consequences for practice. The results of this study are therefore more useable to daily pharmacy practice as they remain contextualised.

Practice level implications are that the VP should be considered as an alternative or complementary educational resource with potential for being used for CPD by pharmacists. The exact strategy for when and how to implement the VP is still speculative and should be based on further research into pharmacy implementation and CPD practices to best target the implementation process. The VP has demonstrated uses for practice and could start to be used in this environment, although implementation needs to be considered so that the CFIR domains are better met (section 9.3.1). This is particularly true for the domains around wider organisational aspects and monetary elements to VP use and implementation.

Implications for policy include that the GPhC could consider the possibility that VPs maybe used as a way of teaching pre-registration trainees in a complementary manner to other resources. The current pre-registration training manual discusses that simulation can be incorporated into learning in order to meet the GPhC pre-registration training standards. This suggests that the GPhC do see a value in simulation, although as discussed in section 2.2, this is a wide concept and thus could be more specific or detailed (General Pharmaceutical Council 2019c). The GPhC go as far as to cite some simulation methods such as role-play and OSCEs but they do not mention technological examples other than ‘’*online training packages*’’. Although this technically does include VPs this is a vague term and examples of what is included in this would be useful. Furthermore, employers and organisations should consider the implementation of VPs with the potential to ease training pressures, although this is largely undemonstrated but rather speculative on the part of the participants. A significant factor of this would be cost, which as discussed in section 9.4, has not yet been considered. This could be considered in further research studies.

For the areas of implementation around both qualified pharmacists, possibly for CPD, and for pre-registration trainees as discussed in the preceding paragraphs, current implementation is likely to be local, by individual organisations or people. This is based on the literature which has been discussed across this study where VPs have largely been developed and used by single organisations, this was also a finding of the systematic review (section 3.4.1). It would be difficult to have a consistent and widespread implementation of this VP unless a national organisation such as Health Education England (HEE) or the GPhC levied for and encouraged, or even took responsibility for, implementation, although this is unlikely for a single VP application but may be possible if a VP 'library', as discussed in section 10.3.4, is developed.

As discussed in section 4.5.3, efforts were taken to demonstrate a level of generalisability of the results of this study. The study has clearly presented the methods and conduct of the research enough for readers to judge if the findings are applicable to their own areas and the questionnaire results in particular used a wider group of participants across England. Thus, the results may have a level of transferability to different population groups of pharmacists and pre-registration trainees across England. Despite this, the VP itself is a specific application to its own context and this study has not discussed its generalisability to other VPs. As was discussed in section 10.4.2, the majority of VPs that have been developed are highly specific to their own contexts and the cross use of VPs in different contexts is low. This links to research recommendations which are discussed in the next section.

10.5.1 Research recommendations

A number of recommendations can be made to develop areas that this work was unable to address. Firstly, there could be further research into the use of VPs for pharmacy technicians. This research study has identified them as a potential VP user and there have been suggestions that they are underprovided for in terms of education and training (Schafheutle *et al.* 2017). On the basis of this, and considering that pharmacy technicians are getting more

responsibility in counselling patients (Langham 2000, Blyth 2008), this could be an area worth investigating. The VP of the study may be suitable for pharmacy technicians and this is a starting point for research although there may also be potential to widen pharmacy technician use of VPs to other applications.

The use of VPs for CPD purposes should continue to be investigated and further research around CPD could have relevance for both pharmacists and pharmacy technicians. This could include a study specifically evaluating how users use a VP for CPD, specifically considering the GPhC's requirements (General Pharmaceutical Council 2018a). Additionally, there appears to be a need for research round CPD generally, particularly around the perspectives of pharmacists on CPD, the need for it and the types of learning they see as being suitable.

In line with the next steps for the VP (section 10.3.4) further research may be required on the basis of any changes and improvements to the VP, this could incorporate a VP 'library' and VPs using different questioning styles.

The last recommendation concerns implementation. There should be research centred around implementation, specifically, concerning the largescale implementation of VPs into organisations such as NHS trusts or community pharmacies. A recognised advantage of VPs is that they require low levels of staff to deliver learning (Bateman *et al.* 2013). In this study, the VP has been shown this to be relevant particularly for the NHS. HEE have a dedicated website for e-Learning on which they state ''*The NHS needed a radically different approach that gave greater flexibility in meeting training needs whist at the same time ensuring that the training received was consistent*'' (Health Education England 2019). They then go on to discuss the advantages of e-Learning for the NHS. This demonstrates that e-Learning, of which VPs are one type, does fit with the current HEE and NHS agenda. Despite this, VPs have not yet been specifically identified by the NHS or HEE as a potential resource to contribute to the e-learning agenda. Future research could address this and consider implementation of the VP into wider

organisations; this should be undertaken using an implementation framework to guide and support the VP's use.

10.6 Application of reflexivity

The background of the reflexive approach to this research was discussed in section 4.5.4. This section will practically present some of the reflexive thoughts and processes which were part of this research and of my personal journey (CR).

The researcher is an integral part of what is studied and reflexivity seeks to value the role of the researcher in analysis by allowing critical self-reflection of the researchers role on the research process (Johnson and Waterfield 2004, Finlay 2010). Prior to the study I had experienced an older version of a VP which aimed to teach 'responding to symptoms' to undergraduate pharmacy students. This VP used considerably older graphics and a 'free text' questioning design. My limited previous experience of VPs meant that I entered into this research with an almost 'blank slate' on which to make judgement.

Prior to embarking on this journey, I had an interest in pharmacy education, this is in part due to a mixed experience of pre-registration training, of training provisions and of varied attitudes of pharmacists in practice. I was a newly qualified pharmacist for the period of this research, and I drew on my personal experiences to include both pre-registration trainees and qualified pharmacists in the evaluation. As part of my pre-registration training, I conducted NOAC counselling and received informal observational training to do so; having experienced first-hand the limitations of this, I have a belief that medication counselling generally, and NOAC counselling specifically, requires additional educational support. Additionally, the NHS hospital trust where I worked as a pre-registration trainee made use of pharmacy technicians to deliver the NOAC counselling which the VP aims to teach. Thus, I was unsurprised by the results concerning pharmacy technicians. Despite this, the results concerning potential use by pharmacy technicians were unprompted.

As I am a newly qualified pharmacist this could have affected relationships with interviewees in both a positive and a negative way. The proximity to pre-registration training and the transition to newly qualified pharmacist meant that I could empathise and appreciate the experiences of these groups slightly more than longer qualified pharmacists. It is hoped that this enabled the participants to speak honestly about their experiences and thoughts of the VP. This is also true for community pharmacists as I worked as a locum pharmacist in this sector during the course of this research and so I had some appreciation of the working and training pressures within this sector. The fact that I was a practising pharmacist ultimately gave access to perspectives which would not be apparent to a non-pharmacist as there was a degree of interpretation and translation of shared knowledge and experience. Throughout the conduct of this research a reflexive diary was kept to note down any reflexive thoughts, the content of the diary is discussed as part of this reflexive discussion (Gale *et al.* 2013).

A particular strength of the reflexive approach to the study was that the interview participants were told that I, as the chief researcher, was independently evaluating the VP and had no role in the VP's development. It was hoped that this would enable participants to speak openly and honestly about the VP without making a judgment about what response the researcher 'wanted' to hear. This was an effort to make sure that personal biases were clear to participants (Mays and Pope 2000, Richards and Emslie 2000).

Reflexivity as a process can contribute to improving work and can aid analysis or interpretation of the results (Finlay 2010). One process within the study where time was taken to incorporate reflexivity was the thematic analysis of the interviews. At the point where this was taking place, I had moved to take up a full-time position as a lecturer of pharmacy practice and work-based learning at the School of Pharmacy at Newcastle University. Due to this, the completion of this thesis occurred alongside this role. This was of benefit to the process of thematic analysis as it took place over a prolonged period of time in which there was the opportunity

for mental gaps from the analysis due to working pressures before which it was returned to. This contributed to the quality and depth of the thematic analysis.

On the topic of thematic analysis, the research itself is a product of my own construct. I acknowledge that the research is distinctive to me, my experiences and perspectives and that a different researcher may have reached alterative conclusions. Despite this, I have attempted to be transparent concerning the construct of themes and the resulting conclusions of the research.

Morse (2015) considered two types of researcher bias which can be limited by the process of reflexivity. The first being unconscious bias in the design of the research. To consider this, the interview guide was internally reviewed to consider its face validity (section 5.5.1) and considerations for any bias in the demographics of participants were discussed in section 6.11.1 relative to the wider pharmacy population.

The second concept of research bias is that there can be a tendency to see what you want to see within the data (Morse 2015). To minimise this, as part of data analysis, minority and contradictory data and negative cases were actively sought in order to deepen the understanding of the data and reveal unanticipated insights when these findings were compared with majority views. This also embraces Morse's (2015) approach to negative case analysis as a way of demonstrating validity. Despite these measures, it should be highlighted that this research is socially contingent and that the responses and the interview experience may have been impacted by any number of factors. This can include, but is not limited to, the time and place of the interview, the respondent’s previous experience of research and their previous experiences of the interview topic. Similarly, my interpretation of the data is socially contingent. I have, where possible tried to be aware of how my own previous experiences have impacted my own perspectives as previously described. Ultimately, this research and its

findings, is of my own interpretation but I hope that I have best represented my participants perspectives and viewpoints to give a realistic and useful view of the VP.

10.7 Conclusion

This research has demonstrated the value of the particular VP application under evaluation both from a technological and educational perspective. Individual users may benefit from using the VP in a number of ways such as through application of knowledge and practicing in a safe environment. A number of types of pharmacy audience who could benefit from using a VP have been debated but ultimately any number of pharmacy professional may find benefits to use of the VP. A number of improvements, developments and further considerations have been discussed including aspects to be addressed prior to any further implementation. If the VP is to be implemented, then a wider and well thought out implementation strategy should be developed which includes the CIFR domains. The VP application is a useful additional resource which should be considered when pharmacy professionals are undertaking educational and training around NOACs.

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Appendices

I. Ethical approval

16/02/2018

Dear Charlotte

PI: Charlotte Richardson
Title: An Evaluation of the use of Virtual Patient Technology in Pharmacist Education on NOACs in Atrial Fibrillation
Ref: ERP1361

Thank you for submitting your application for review. The proposal was reviewed by the Panel Chair. I am pleased to inform you that your application has been approved by the Ethics Review Panel.

If the fieldwork goes beyond the date stated in your application, or there are any amendments to your study you must submit an 'application to amend study' form to the ERP administrator at research.governance@keele.ac.uk. This form is available via http://www.keele.ac.uk/researchsupport/researchethics/

If you have any queries please do not hesitate to contact me, in writing, via the ERP administrator, at research.governance@keele.ac.uk stating **ERP1361** in the subject line of the e-mail.

Yours sincerely
PP.

Dr Andrew Rutherford
Chair – Ethical Review Panel

II. Health Research Authority approval

Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales

NHS
Health Research Authority

Prof Stephen Chapman
School of Pharmacy
Keele University
Keele
ST5 5BG

Email: hra.approval@nhs.net
Research-permissions@wales.nhs.uk

25 July 2018

Dear Prof Chapman

HRA and Health and Care Research Wales (HCRW) Approval Letter

Study title:	**The evaluation of a virtual patient programme to teach pharmacists NOAC counselling in atrial fibrillation**
IRAS project ID:	**235213**
Protocol number:	**RG-0277-18-PHARM**
Sponsor	**Keele University**

I am pleased to confirm that HRA and Health and Care Research Wales (HCRW) Approval has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

How should I continue to work with participating NHS organisations in England and Wales?
You should now provide a copy of this letter to all participating NHS organisations in England and Wales, as well as any documentation that has been updated as a result of the assessment.

Participating NHS organisations in England and Wales will not be required to formally confirm capacity and capability before you may commence research activity at site. As such, you may commence the research at each organisation 35 days following sponsor provision to the site of the local information pack, so long as:

- You have contacted participating NHS organisations (see below for details)
- The NHS organisation has not provided a reason as to why they cannot participate
- The NHS organisation has not requested additional time to confirm.

You may start the research prior to the above deadline if the site positively confirms that the research may proceed.

If not already done so, you should now provide the local information pack for your study to your participating NHS organisations. A current list of R&D contacts is accessible at the NHS RD Forum website and these contacts MUST be used for this purpose. After entering your IRAS ID you will be

able to access a password protected document (password: **Summer14**). The password is updated on a monthly basis so please obtain the relevant contact information as soon as possible; please do not hesitate to contact me should you encounter any issues.

Commencing research activities at any NHS organisation before providing them with the full local information pack and allowing them the agreed duration to opt-out, or to request additional time (unless you have received from their R&D department notification that you may commence), is a breach of the terms of HRA and HCRW Approval. Further information is provided in the "*summary of assessment*" section towards the end of this document.

It is important that you involve both the research management function (e.g. R&D office) supporting each organisation and the local research team (where there is one) in setting up your study. Contact details of the research management function for each organisation can be accessed here.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?
HRA and HCRW Approval does not apply to NHS/HSC organisations within the devolved administrations of Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report (including this letter) has been sent to the coordinating centre of each participating nation. You should work with the relevant national coordinating functions to ensure any nation specific checks are complete, and with each site so that they are able to give management permission for the study to begin.

Please see IRAS Help for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?
HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to obtain local agreement in accordance with their procedures.

What are my notification responsibilities during the study?
The document "*After Ethical Review – guidance for sponsors and investigators*", issued with your REC favourable opinion, gives detailed guidance on reporting expectations for studies, including:

- Registration of research
- Notifying amendments
- Notifying the end of the study

The HRA website also provides guidance on these topics, and is updated in the light of changes in reporting expectations or procedures.

I am a participating NHS organisation in England or Wales. What should I do once I receive this letter?
You should work with the applicant and sponsor to complete any outstanding arrangements so you are able to confirm capacity and capability in line with the information provided in this letter.

The sponsor contact for this application is as follows:

Name: Dr Clark Crawford
Email: research.governance@keele.ac.uk

Who should I contact for further information?
Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **235213**. Please quote this on all correspondence.

Yours sincerely

Thomas Fairman
HRA Assessor

Email: hra.approval@nhs.net

Copy to: *Dr Clark Crawford, Keele University, (Sponsor Contact)*
Hilary Allan, NIHR Clinical Research Network North East and North Cumbria, (Lead NHS R&D Contact)

III. Consent form and participant information sheet - questionnaire

The consent form and participant information sheet which was used for respondents is available at https://goo.gl/forms/TnK4HoDFDM4XlTiw1 and is also shown below.

Virtual Patient Programme Consent Form

*Required

An Evaluation of the use of a Virtual Patient Programme in Pharmacist and Pre-registration Pharmacist Education

Participant Information

My name is Charlotte Richardson and I am a pharmacist and PhD student. I am conducting research into using virtual patients to develop the consultation skills of pharmacists and pre-registration pharmacists surrounding atrial fibrillation and the anticoagulant, rivaroxaban. I am inviting you to take part in this research study, you do not have to take part but before you decide, it is important for you to understand why the research study is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me (c.l.richardson@keele.ac.uk) if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this information.

What is the purpose of the study?
This research aims to evaluate the use of an educational intervention for pharmacists and pre-registration pharmacists on the topic of anticoagulants in atrial fibrillation. The intervention uses virtual patients in an online computer based programme.

Why have I been chosen?
You are being invited to take part in this research study because you are a practising pharmacist or pre-registration pharmacist.

What will happen to me if I take part and what do I have to do?
If you decide to take part you will be invited to complete an evaluation at a time and location convenient to yourself. You will be asked to complete an initial questionnaire taking around 5 minutes before being asked to trial a new educational intervention programme on atrial fibrillation. Use of the educational programme should take no more than 20 minutes. You will then be asked to complete a follow-up questionnaire after completion of the intervention around 5-10 minutes in length. In total your participation should take around 30 minutes.

Do I have to take part?
It is up to you to decide whether or not to take part. If you choose to take part you will first be asked to confirm your consent and you can still withdraw at any time up to 48 hours after the submission of your completed questionnaire. You do not have to give a reason.

What are the possible disadvantages and risks of taking part?
We are not aware of any disadvantages or risks to you in taking part in the study. The educational tool is not of a sensitive nature and pertains to routine clinical practice.

What are the possible benefits of taking part?
The may be an improvement in your consultation skills with regards to patients with atrial fibrillation taking oral anticoagulants. You would also be contributing to the development of a new educational tool.

What if there is a problem or something goes wrong?
You can contact me Charlotte Richardson if you wish to complain, or have any concerns about any aspect about any way you have been approached or treated during the course of this study. I will consider such reports promptly and take appropriate action immediately. Alternatively, you may contact the Head of the School of Pharmacy at Keele University (Professor Nigel Ratcliffe, email address n.ratcliffe@keele.ac.uk). If you are at all unhappy about any aspect of the way that you have been approached or treated during the course of the study please write to the Research Integrity Team, who are Keele University's contact for complaints regarding research at the following address: Research Integrity Team Directorate of Research, Innovation and Engagement IC2 Building, Keele University, ST5 5NE Email: research.governance@keele.ac.uk. Tel: 01782 733371.

Who will have access to information about me?
Any personally identifiable information that we collect about you during the course of the research will be kept strictly confidential and stored on the online questionnaire, this included any information you provide as part of the questionnaire. Your employer may be aware you are taking part in this study, they too will not have any access to your data or responses, these are treated as strictly confidential and are only available to the research team. Electronic data containing information about you will only be stored on password-protected, encrypted media at Keele University that only I and my supervisor (Professor Stephen Chapman) have access to. Hardcopies of data and other documentation containing information about you will be kept secure in a locked cupboard that only my supervisor and I have access to. At the end of the study (Sep 2020) all identifiable data will be destroyed, other study data will be kept for a minimum of 10 years before being securely destroyed. You will not be able to be identified in any reports or publications. Keele University may have access to the data for audit purposes.

Keele University is the sponsor for this study based in the United Kingdom. We will be using information from you in order to undertake this study and will act as the data controller for this study. This means that we are responsible for looking after your information and using it properly. Keele University will keep identifiable information about you until the study has finished (September 2020). Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. You can find out more about how we use your information at
https://www.keele.ac.uk/informationgovernance/checkyourinformationisbeinghandledcorrectly/privacynotice-researchparticipants/
How will information about me be used?
The results (including anonymised short direct quotes) will be included in a research report as part of a PhD at Keele University, and may subsequently be published as research papers in academic journals and presented at conferences. No individual person will be identifiable in any direct quotes, reports, papers, presentations or summaries. The results of the study might also be used for additional or subsequent research.

Who is organising and funding the research?
The study is being organised and funded by the School of Pharmacy at Keele University. Bayer AG, commissioned and paid for the virtual patient educational programme.

Who has reviewed the study?
The research study has been approved by Keele University Research Ethics and Governance Committee.

Further Information and Contact Details
If you have any questions or require any further information, either now or at any time during the study, please contact me (Charlotte Richardson) at c.l.richardson@keele.ac.uk. Alternatively, you can contact me in writing at the School of Pharmacy, Keele University, Staffordshire ST5 5BG.

Thank you for taking time to read this information

Charlotte Richardson

PhD Student
c.l.richardson@keele.ac.uk
+447914229370

An Evaluation of the use of a Virtual Patient Programme in Pharmacist and Pre-registration Pharmacist Education

Consent Form

1. I confirm that I have read and understood the information sheet (version 3.1 12/06/2018) for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw up until 48 hours after I have completed the final evaluation.

3. I understand that data collected about me during this study will be anonymised before it is submitted for publication.

4. I agree to the use of quotes from responses which will be anonymised in publication.

5. I agree to being contacted via email to take part in further research regarding this project.

1. **Full name** *

2. **Email address** *

3. **To consent to take part in this study, please tick the box and submit the form below** *
   Tick all that apply.
   - [ ] Agree

4. **If you wish to be informed of the study results and any publications resulting from the study please indicate by adding your email below**

Charlotte Richardson

PhD Student
c.l.richardson@keele.ac.uk
+447914229370

IV. Consent form and participant information sheet - interviews

The consent form and participant information sheet which was used for participants taking part in interviews is available at https://goo.gl/forms/KQYCoJL28s5p1e9j1 and is also shown below.

Virtual Patient Programme Consent Form

*Required

An Evaluation of the use of a Virtual Patient Programme in Pharmacist and Pre-registration Pharmacist Education

Participant Information

My name is Charlotte Richardson and I am a pharmacist and PhD student. I am conducting research into using virtual patients to develop the consultation skills of pharmacists and pre-registration pharmacists surrounding atrial fibrillation and the anticoagulant, rivaroxaban. I am inviting you to take part in this research study, you do not have to take part but before you decide, it is important for you to understand why the research study is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me (c.l.richardson@keele.ac.uk) if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this information.

What is the purpose of the study?
This research aims to evaluate the use of an educational intervention for pharmacists and pre-registration pharmacists on the topic of anticoagulants in atrial fibrillation. The intervention uses virtual patients in an online computer based programme.

Why have I been chosen?
You are being invited to take part in this research study because you are a practising pharmacist or pre-registration pharmacist and you have already completed an evaluation of the programme via questionnaire.

What will happen to me if I take part and what do I have to do?
If you decide to take part you will be invited to trial the new educational intervention programme on atrial fibrillation again, this should take no more than 20 minutes and can be done at any time or location. Following this, you will undergo an interview with one of the researchers. The interview may last up to one hour and will be audio recorded. The interview will cover key topics including use of the intervention programme, past experiences of counselling on atrial fibrillation, if any, and future use of the technology.

Do I have to take part?
It is up to you to decide whether or not to take part. If you choose to take part you will first be asked to confirm your consent and you can still withdraw at any time up to completion of the interview. You do not have to give a reason.

Will I be recorded, and how will the recorded media be used?
The digital recording of the discussion made during this research project will be used only for analysis. No other use will be made of it without your written permission, and no one outside of the project will be allowed access to the original recordings. Keele University may have access to study data for audit purposes. An external company, The Transcription Company UK, is used to transcribe audio recordings via a data sharing agreement. All data will be handle anonymously.

What are the possible disadvantages and risks of taking part?
We are not aware of any disadvantages or risks to you in taking part in the study. The educational tool is not of a sensitive nature and pertains to routine clinical practice.

What are the possible benefits of taking part?
There may be an improvement in your consultation skills with regards to patients with atrial fibrillation taking oral anticoagulants. You would also be contributing to the development of a new educational tool.

What if there is a problem or something goes wrong?
You can contact me Charlotte Richardson if you wish to complain, or have any concerns about any aspect about any way you have been approached or treated during the course of this study. I will

consider such reports promptly and take appropriate action immediately. Alternatively, you may contact the Head of the School of Pharmacy at Keele University (Professor Nigel Ratcliffe, email address n.ratcliffe@keele.ac.uk). If you are at all unhappy about any aspect of the way that you have been approached or treated during the course of the study please write to the Research Integrity Team, who are Keele University's contact for complaints regarding research at the following address: Research Integrity Team Directorate of Research, Innovation and Engagement IC2 Building, Keele University, ST5 5NE Email: research.governance@keele.ac.uk. Tel: 01782 733371.

Who will have access to information about me?
Any personally identifiable information that we collect about you during the course of the research will be kept strictly confidential. Your employer may be aware you are taking part in this study, they too will not have any access to your data or responses, these are treated as strictly confidential and are only available to the research team. Electronic data containing information about you will only be stored on password-protected, encrypted media that only I and my supervisor (Professor Stephen Chapman) have access to. Hardcopies of data and other documentation containing information about you will be kept secure in a locked cupboard that only my supervisor and I have access to. At the end of the study (Sep 2020) all identifiable data will be destroyed, interview recordings may be kept for up to one year, other study data, namely interview transcripts will be kept for a minimum of 10 years before being securely destroyed. Data will be retained for further research use in this time and will be stored securely on a server at Keele University that only the research team has access to. You will not be able to be identified in any reports or publications. Keele University may have access to the data for audit purposes.

Keele University is the sponsor for this study based in the United Kingdom. We will be using information from you in order to undertake this study and will act as the data controller for this study. This means that we are responsible for looking after your information and using it properly. Keele University will keep identifiable information about you until the study has finished (September 2020). Your rights to access, change or move your information are limited, as we need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally-identifiable information possible. You can find out more about how we use your information at at
https://www.keele.ac.uk/informationgovernance/checkyourinformationisbeinghandledcorrectly/privacynotice-researchparticipants/
How will information about me be used?
The results (including anonymised short direct quotes) will be included in a research report as part of my degree in pharmacy at Keele University, and may subsequently be published as research papers in academic journals and presented at conferences. No individual person will be identifiable in any direct quotes, reports, papers, presentations or summaries. The results of the study might also be used for additional or subsequent research

Who is organising and funding the research?
The study is being organised and funded by the School of Pharmacy at Keele University. Bayer AG, commissioned and paid for the virtual patient educational programme.

Who has reviewed the study?
The research study has been approved by Keele University Research Ethics and Governance Committee.

Further Information and Contact Details
If you have any questions or require any further information, either now or at any time during the study, please contact me (Charlotte Richardson) at c.l.richardson@keele.ac.uk. Alternatively, you can contact me in writing at the School of Pharmacy, Keele University, Staffordshire ST5 5BG.

Thank you for taking time to read this information

Charlotte Richardson

PhD Student
c.l.richardson@keele.ac.uk
+447914229370

Consent Form

1. I confirm that I have read and understood the information sheet (version 3.1 12/06/2018) for the above study and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw up until I have completed the final evaluation.

3. I understand that data collected about me during this study will be anonymised before it is submitted for publication.

4. I agree to the use of quotes from responses which will be anonymised in publication.

5. I agree to the interview being audio recorded.

1. **Full name** *

2. **Email address** *

3. **To consent to take part in this study, please tick the box and submit the form below** *
   Tick all that apply.

   ☐ Agree

4. **If you wish to be informed of the study results and any publications resulting from the study please indicate by adding your email below**

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V. Questionnaire

The online study questionnaire is available at https://goo.gl/forms/Tcrcr7KIVKa6jxCU2 and is also shown below.

Virtual Patient Programme Questionnaire

*Required

An Evaluation of the use of a Virtual Patient Programme in Pharmacist and Pre-registration Pharmacist Education

Demographic Questions

1. **Please provide your full name** *

2. **Please provide your email address** *

3. **Please indicate which gender you identify with** *
Mark only one oval.
- ◯ Female
- ◯ Male
- ◯ Prefer not to say
- ◯ Other: _____

4. **Which age group best describes you?** *
Mark only one oval.
- ◯ 20-29 years
- ◯ 30-39 years
- ◯ 40-49 years
- ◯ 50-59 years
- ◯ Older than 60 years

5. **How long have you been qualified as a pharmacist?** *
Mark only one oval.
- ◯ Pre-registration trainee - yet to qualify
- ◯ Less than 5 years
- ◯ 5-10 years
- ◯ 11-20 years
- ◯ More than 20 years

6. **In what pharmacy sector is your primary role?** *
Mark only one oval.

- ◯ Hospital
- ◯ Community
- ◯ Other: _____

7. **Which NHS trust, organisation or company do you primarily work for? (please provide an address of the pharmacy)** *

_____

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Pre-intervention Questions

8. **Please answer the following questions about NOAC counselling, using the scales provided** *
Mark only one oval per row.

	Never	Once in a while	Occasionally	Regularly	Very frequently
How often do you counsel patients on non vitamin K oral anticoagulants (NOACs) e.g. rivaroxaban for atrial fibrillation?	◯	◯	◯	◯	◯

9. *
Mark only one oval per row.

	Not at all	Slightly	Moderately	Quite	Extremely
How confident are you counselling patients on NOACs for atrial fibrillation?	◯	◯	◯	◯	◯
How interested do you think pharmacists and pre-registration pharmacists would be in learning more about counselling on NOACs in atrial fibrillation?	◯	◯	◯	◯	◯
How useful do you think learning about NOAC counselling in atrial fibrillation would be for pharmacists and pre-registration pharmacists?	◯	◯	◯	◯	◯

10. **What are you prior experiences of using virtual patients? Please include any exposure or experience you have had using virtual patients, the type of virtual patient used and in what context.** *

_____

_____

_____

_____

_____

11. **Have you received any training regarding counselling on NOACs and atrial fibrillation? Please describe below including the nature of any education and training, when it occurred, what was involved and whether it was formal or in-formal.** *

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Pre-intervention Questions

Counselling on NOACs in atrial fibrillation

12. **For each of the following statements, please indicate, using the scale, your overall current ability to counsel a patient on the given topic.** *

Mark only one oval per row.

	Very poor	Poor	Neither good nor bad	Good	Very good
What atrial fibrillation is	◯	◯	◯	◯	◯
What a diagnosis of atrial fibrillation means	◯	◯	◯	◯	◯
How NOACs work in atrial fibrillation	◯	◯	◯	◯	◯
The importance of NOAC adherence	◯	◯	◯	◯	◯
The risks and benefits involved in NOAC use in atrial fibrillation	◯	◯	◯	◯	◯
The rivaroxaban regimen used in atrial fibrillation	◯	◯	◯	◯	◯
Rivaroxaban administration e.g. food and timings	◯	◯	◯	◯	◯
What to do in the case of a missed dose including discussing the time limits involved with taking a missed dose late	◯	◯	◯	◯	◯
The differences between major and minor bleeding and in what cases further medical advice is required	◯	◯	◯	◯	◯
Considerations for taking other medications alongside rivaroxaban	◯	◯	◯	◯	◯
The purpose and importance of an anti-coagulation card	◯	◯	◯	◯	◯

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Skip to "Virtual Patient Programme."

Virtual Patient Programme

Please take your time to access the virtual patient case at:
https://www.keelevp.com/virtual-patient/newly-diagnosed-af-patient

Take as much time as you like and have as many goes at the case as you need before completing the post intervention questions. You will also be free to access the case after you have completed the study questions.

13. **For each of the following questions on the use of the virtual patient system, please answer using the scale** *

Mark only one oval per row.

	Not at all	Slightly	Moderately	Quite	Extremely
How enjoyable did you find using the virtual patient programme?					
How comfortable were you using the virtual patient technology?					
How difficult did you find the virtual patient programme to use?					
How useful did you find the virtual patient programme?					
How likely are you to use the programme again?					
How likely are you to recommend the programme to a colleague?					

14. **For each of the following statements please indicate your level of agreement or disagreement, using the scale.** *

Mark only one oval per row.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The scenario was realistic to practice					
The scenario played out much like it would in practice					
The multiple choice responses met the needs of what I wanted to say to the patient					
The patient's responses were realistic.					
The scenario helped me practice how to host a consultation on this topic					
The feedback provided at the end of the case was sufficient to guide my learning					
I liked the method of feedback at the end of the case when the patient verbally discusses my performance					
The virtual patient programme fulfilled its aim of teaching how to counsel a new patient on rivaroxaban for atrial fibrillation					
The virtual patient programme increased my knowledge regarding counselling on NOACs for atrial fibrillation.					
The virtual patient programme increased my confidence regarding counselling on NOACs for atrial fibrillation					
As a result of using the virtual patient programme, in the future I will change my practice when counselling patients on NOACs for atrial fibrillation					

15. **Please rank the following outcomes in terms of the way the virtual patient programme impacted your learning and development. 1 being the smallest impact to 5 being the largest impact.** *

Mark only one oval per row.

	Smallest impact 1	2	3	4	Largest impact 5
Change of knowledge regarding counselling on NOACs in atrial fibrillation					
Change of confidence counselling on NOACs in atrial fibrillation					
Contribution to continuing professional development					
Development of generic consultation skills					
Change of knowledge regarding NOAC use in indications other than atrial fibrillation					

16. **What was the best thing about the virtual patient programme?** *

17. **What was the worst thing about the virtual patient programme?** *

18. **What impact do you think the virtual patient programme could have on patient care?** *

19. **Do you have any recommendations on how the virtual patient programme could be improved or developed?** *

20. **Do you have any further comments to add?**

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Post-intervention Questions

21. **For each of the following statements, please indicate, using the scale, your overall ability to counsel a patient on the given topic after using the virtual patient programme.** *
Mark only one oval per row.

	Very poor	Poor	Neither good nor poor	Good	Very good
What atrial fibrillation is					
What a diagnosis of atrial fibrillation means					
How NOACs work in atrial fibrillation					
The importance of NOAC adherence					
The risks and benefits involved in NOAC use in atrial fibrillation					
The rivaroxaban regimen used in atrial fibrillation					
Rivaroxaban administration e.g. food and timings					
What to do in the case of a missed dose including discussing the time limits involved with taking a missed dose late					
The differences between major and minor bleeding and in what cases further medical advice is required					
Considerations for taking other medications alongside rivaroxaban					
The purpose and importance of an anti-coagulation card					

Thank you for taking the time to complete this questionnaire

Please feel free to return to the virtual patient case and use it as you wish.

VI. Interview guide

Interview guide
An Evaluation of the use of Virtual Patient Technology in Pharmacist Education on Atrial Fibrillation

Overview

1. Greetings, welcome, explanation of the structure of the session and the interviewer's role.
2. Confirmation of informed consent and that the participant has used the VP intervention.
3. A semi-structured interview see guide below.
4. Summary and closing remarks. Opportunity for further questions from the participant. Contact details and dissemination of the study results highlighted. Thanks.

Interview Plan

a) Tell me about your current and past roles in pharmacy.

b) Experiences of AF and NOACs
- What are your experiences to date of NOACs and AF?
  Probe: What about the patients with AF on NOACs?
- Tell me your thoughts and feelings on education and counselling for pharmacists on NOACs in AF
  Prompt: What are your experiences of education and training for NOACs in AF?
  Probe: Do you think more education and training is needed?

c) Experiences of virtual patients
- What are your experiences to date of VPs?
  Prompt: Prior to today, had you heard of/experienced/used VPs? When and what for? Did you have a good or bad experience?
- What are your feelings towards using VPs? …… And why?

d) VPs as an educational tool in Pharmacy
- What are your thoughts on using VPs as an educational tool in pharmacy?
  Probe: What about specifically for AF and NOAC education and training?
  Probe: How does the use of VPs compare to other E&T methods?
  Probe: What are your feelings towards VP use in practice?
  Probe: What sort of impact do you think the VP intervention could have on patients?

e) VPs: The Technology
- Describe your thoughts regarding the intervention program
  Probes: Is there anything you want to discuss about the program,
  Are there any good points or advantages you want to highlight?
  Are there any improvements you can suggest?
  Are there any negative points or disadvantages to raise?
  Are there any changes you would make to the program?
- Do you have any further comments regarding the technology, case or program?
- What are your feelings towards the VP technology and case?
- Do you think that by using the program you are better prepared to counsel NOAC taking AF patients? …. Why?
- Do you think that you are more likely to conduct these counsellings? …. Why?
  Prompt: Do you think your practice will change as a result of using the program?

f) Further comments
- Is there anything else you would like to tell me or discuss?
  Prompt: Any other comments you wish to add or any further feedback on the program?
- Are there any questions you would like to ask me?

VII. Questionnaire analysis by sector of practice

	How likely are you to recommend the programme to a colleague?	How likely are you to use the programme again?	How useful did you find the virtual patient programme?	How difficult did you find the virtual patient programme to use?	How comfortable were you using the virtual patient technology?	How enjoyable did you find using the virtual patient programme?	How useful do you think learning about NOAC counselling in atrial fibrillation would be for pharmacists and pre-registration pharmacists?	How interested do you think pharmacists and pre-registration pharmacists would be in learning more about counselling on NOACs in atrial fibrillation?	How confident are you counselling patients on NOACs for atrial fibrillation?	How often do you counsel patients on non-vitamin K oral anticoagulants (NOACs) e.g. rivaroxaban for atrial fibrillation?
Community	Quite	Quite	Quite	Not at all	Quite	Quite	Extremely	Quite	Occasionally	Occasionally
Hospital	Quite	Quite	Quite	Not at all	Quite	Quite	Extremely	Quite	Quite	Occasionally

	As a result of using the virtual patient programme, in the future I will change my practice when counselling patients on NOACs for atrial fibrillation	The virtual patient programme increased my confidence regarding counselling on NOACs for atrial fibrillation	The virtual patient programme increased my knowledge regarding counselling on NOACs for atrial fibrillation.	The virtual patient programme fulfilled its aim of teaching how to counsel a new patient on rivaroxaban for atrial fibrillation	I liked the method of feedback at the end of the case when the patient verbally discusses my performance	The feedback provided at the end of the case was sufficient to guide my learning	The scenario helped me practice how to host a consultation on this topic	The patient' s responses were realistic.	The multiple-choice responses met the needs of what I wanted to say to the patient	The scenario played out much like it would in practice	The scenario was realistic to practice
Community	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree
Hospital	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree

Table 1. Responses to questions on the frequency of NOAC counselling, confidence and the interest and usefulness of the VP and of the usability and satisfaction questions split by sector of practice

VIII. Questionnaire analysis by qualification status

	How likely are you to recommend the programme to a colleague?	How likely are you to use the programme again?	How useful did you find the virtual patient programme?	How difficult did you find the virtual patient programme to use?	How comfortable were you using the virtual patient technology?	How enjoyable did you find using the virtual patient programme?	How useful do you think learning about NOAC counselling in atrial fibrillation would be for pharmacists and pre-registration pharmacists?	How interested do you think pharmacists and pre-registration pharmacists would be in learning more about counselling on NOACs in atrial fibrillation?	How confident are you counselling patients on NOACs for atrial fibrillation?	How often do you counsel patients on non-vitamin K oral anticoagulants (NOACs) e.g. rivaroxaban for atrial fibrillation?
Qualified	Quite	Quite	Quite	Not at all	Quite	Quite	Extremely	Quite	Quite	Occasionally
Pre-registration trainee	Quite	Quite	Quite	Not at all	Extremely	Quite	Extremely	Quite	Quite	Once in a while

	As a result of using the virtual patient programme, in the future I will change my practice when counselling patients on NOACs for atrial fibrillation	The virtual patient programme increased my confidence regarding counselling on NOACs for atrial fibrillation	The virtual patient programme increased my knowledge regarding counselling on NOACs for atrial fibrillation.	The virtual patient programme fulfilled its aim of teaching how to counsel a new patient on rivaroxaban for atrial fibrillation	I liked the method of feedback at the end of the case when the patient verbally discusses my performance	The feedback provided at the end of the case was sufficient to guide my learning	The scenario helped me practice how to host a consultation on this topic	The patient' s responses were realistic.	The multiple-choice responses met the needs of what I wanted to say to the patient	The scenario played out much like it would in practice	The scenario was realistic to practice
Qualified	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree
Pre-registration trainee	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree	Agree

Table 1. Responses to questions on the frequency of NOAC counselling, confidence and the interest and usefulness of the VP and of the usability and satisfaction questions split by qualification status

Charlotte Lucy Richardson