Introduction

Prior to the Pandemic Influenza Preparedness (PIP) Framework being enacted by the World Health Organisation (WHO) in 2011, much discussion on access to pandemic influenza vaccines ('PIVs') had centred on the fact that samples of the virus used to produce a PIV were likely to have been supplied by developing states, which then struggled to purchase the resulting vaccine.[1] A major impetus for the creation of the Framework was the 2005-H5N1 virus sharing incident, during which Indonesia departed from the established norm of sharing pandemic influenza samples with the WHO.[2] Indonesia claimed that the samples were the sovereign property of the State of Indonesia, and it was under no obligation to share them with the wider international community.[3] The Indonesian Government cited an unfair lack of correlation between sharing samples and the benefits obtained in return as the primary reason for refusing to share samples.[4] Indeed, it was acknowledged by the WHO Intergovernmental Meeting on Pandemic Influenza Preparedness that the pre-PIP system did not deliver fairness, transparency or equity to developing states,[5] and disproportionately benefited developed states with their own vaccine manufacturing base, by allowing easy access to viral samples with which to develop a vaccine with no clear obligations to share the benefits.

This argument is not without merit. During the 2009-H1N1 pandemic, there were significant disparities in vaccination coverage between developed and developing states: developed states were able to procure more vaccine, and procure it earlier in the pandemic, than developing states.[6] Since 2009-H1N1 global manufacturing capacity for PIVs has increased from nearly 800 million doses per annum in 2009,[7] to 6.372 billion doses in 2015 doses per annum at the most recent estimation in 2015.[8] However, 75% of the global influenza manufacturing capacity is dedicated to meeting the needs of developed states in the Northern Hemisphere.[9] It is therefore unlikely that any increase in manufacturing capacity will have a beneficial effect on pandemic preparedness in developing states, meaning that developing

states will continue to be reliant upon donations from the WHO for access to the PIV. Through the PIP Framework the WHO sought to create a more formal method of procurement of vaccines for onward donation to developing states, in order to alleviate some of the problems highlighted by 2009-H1N1, and the Indonesian virus sharing incident respectively.[10] The process of enacting what eventually became the PIP Framework began in 2007,[11] with the passing of Resolution WHA 60.28 by the World Health Assembly. In this Resolution the Assembly required that the WHO Director- General

> formulate mechanisms and guidelines, in close consultation with Member States, aimed at ensuring fair and equitable distribution of pandemic-influenza vaccines at affordable prices in the event of a pandemic, in order to ensure timely availability of such vaccines to Member States in need.[12]

The Framework provides obligations and recommendations in two areas: first, the timely sharing of influenza viral samples with human pandemic potential between member states of the WHO Global Influenza Surveillance and Response System[13] (GISRS); and second, the sharing of viral samples with entities that operate outside of GISRS, such as vaccine manufacturers, in return for these external entities sharing benefits with the WHO and its members.[14] The Framework aims to improve the procurement of PIV by developing states[15] by creating a more structured approach to collection and distribution of donated PIV than the ad-hoc manner in which the WHO has collected and donated vaccines in previous pandemics. This is intended to ensure that the PIV donated by manufacturers is not just given on an ad-hoc basis after orders from fee-paying states have been fulfilled, or once self-procuring states have determined they have excess PIV to meet their needs, as was the case with donations during 2009-H1N1.[16] Instead, donations of PIV may be included within the company obligations within Standard Material Transfer Agreements (SMTA)[17] completed via the PIP Framework. These mandate that a proportion of the real-time PIV production is reserved for,

and transferred to the WHO for onward donation to developing states, in return for the WHO sharing influenza viral samples with human pandemic potential.[18]

The Framework has been hailed as an innovative mechanism for guaranteeing access to vaccines and affordable life-saving drugs during an influenza pandemic.[19] A number of papers have considered the PIP Framework, and attempted to determine the impact the vaccine stockpile it creates will have on procurement of PIV in developing states. However, some of the literature expresses concern that the Framework is unable to make any real changes to vaccine allocation due to its inability to close the gap between developed and developing states where procurement of PIV is concerned.[20] This literature has only considered the benefit sharing provisions of the SMTAs as they were presented in the Appendix of the PIP Framework, as at the time, no SMTAs had been concluded with PIV manufacturers. The major development since this literature was generated is the fact that nine SMTAs have now been concluded between the WHO and pandemic influenza vaccine manufacturers. Each of these agreements outlines the 'Obligations of the Company' agreed between the WHO and pandemic influenza vaccine manufacturers, and it is the content of these obligations which is the focus of this paper. Through examining the content of the 'Obligations of the Company' which have been secured by the WHO I argue this paper gives a clearer indication of the true practical impact the PIP stockpile will have on procurement of PIV during the next pandemic.

The PIP Framework and vaccine procurement

The PIP Framework enables the WHO to manage a stockpile of approximately 150 million doses of PIV. This stockpile is created by requiring vaccine manufacturers who receive pandemic influenza virus samples from the WHO for vaccine development to contribute to the stockpile, via an SMTA. The stockpile is a virtual one, influenza vaccine manufacturer commit to supply a proportion of their real-time vaccine production to the WHO, and in the event of an influenza pandemic, vaccine manufacturers supply x% of their real-time production to the WHO, and the WHO will then transfer from the stockpile to recipient states. The Framework provides that

> 50 million doses of the stockpile will be for use in 'affected countries, according to public health risk and need, to assist in containing the first outbreak or outbreaks of an emerging pandemic and 100 million for distribution….to developing countries that have no or inadequate access to....influenza vaccines, on a per capita basis that can be distributed to affected and at risk developing states during a pandemic.[21]

Of particular note is the fact that the obligation that PIV manufactures have to contribute vaccine to the PIP stockpile is to be fulfilled at the same time as manufacturers' contractual commitments to self-procuring states, including those with Advance Purchase Agreements in place[22], which was not the case during 2009-H1N1.[23] This means that those developing states procuring vaccine from the PIP stockpile are intended to receive their vaccine in the same timeframe as self-procuring states, thereby ensuring that developing states can vaccinate members of their population earlier in the pandemic, which is crucial in reducing disease transmission, and preventing mortality and morbidity from a pandemic influenza virus.[24]

The PIP Framework can rightly be described as a 'milestone for global health'[25] based solely on the fact that it is the first international agreement that has sought to address inequalities in virus sharing by developing states, and procurement of medical technologies stemming from such viruses. However, closer scrutiny of the terms and conditions the WHO has managed to secure in SMTA negotiations makes the Framework appear less impressive.

PIP commitments

PIV manufacturers who wish to receive PIP biological materials[26] by way of a Standard Material Transfer Agreement with the WHO must commit to at least two of the following options

> A1. Donate at least 10% of real time pandemic vaccine production to WHO.
> A2. Reserve at least 10% of real time pandemic vaccine production at affordable prices to WHO.

A3. Donate at least X treatment courses of needed antiviral medicine for the pandemic to WHO. A4. Reserve at least X treatment courses of needed antiviral medicine for the pandemic at affordable prices.

A5. Grant to manufacturers in developing countries licenses on mutually agreed terms that should be fair and reasonable including in respect of affordable royalties, taking into account development levels in the country of end use of the products, on technology, know-how, products and processes for which it holds intellectual property rights for the production of (i) influenza vaccines, (ii) adjuvants, (iii) antivirals and/or (iv) diagnostics.

A6. Grant royalty-free licenses to manufacturers in developing countries or grant to WHO royalty-free, non-exclusive licenses on IPR, which can be sublicensed, for the production of pandemic influenza vaccines, adjuvants, antivirals products and diagnostics needed in a pandemic. WHO may sublicense these licenses to manufacturers in developing countries on appropriate terms and conditions and in accordance with sound public health principles.[27]

These benefit sharing provisions of the Framework have been met with a good deal of support in the literature, on the basis that they will ensure increased access to vaccines for developing states during an influenza pandemic.[28] This support is given on the basis that paragraphs 4.1.A.1 and 4.1.A.2 appear to commit manufacturers to provide *at least* 10% of their real time production to the WHO. However, the above provision has an accompanying footnote '[r]ecognizing that flexibility is important in negotiating with all manufacturers, in a range of 5–20%.'[29] Despite the fact that the Chair of the PIP negotiations envisioned that SMTAs would be 'standardised, universal and globally applicable to all transfers of PIP biological materials and not subject to further negotiation'[30], there does appear to be a significant amount of flexibility within the SMTA provided in the Framework. These flexible terms afford PIV manufacturers scope to negotiate terms regarding the donation of vaccines, antivirals, the granting of licenses, and transfer of technology. In addition, the relevant articles on liability and indemnities, warranties, duration and termination of contracts, governing law, and dispute resolution are not standardised within the Framework and remain simply 'to be agreed by the parties'.[31]

This is concerning for a number of reasons. Firstly, the fact that so many terms within the SMTA need to be agreed upon by the parties is likely to elongate the negotiation process[32]; and given the fact that influenza pandemics are sporadic in nature, it is not entirely clear to what extent such a delay in the negotiations will impact on procurement from the stockpile during an influenza pandemic. Secondly, if it is not possible to reach a consensus on *all* the flexible terms, the negotiations will fail, and the SMTA will not enter into force, thereby leading to fewer vaccines being available for the PIP vaccine stockpile. Moreover, the fact that so much of the SMTA is flexible and subject to negotiation will likely provide the manufacturer with a stronger negotiating position than the WHO, as the manufacturer will be one of a very limited number of providers of a product that is in very high demand, and the WHO will be one of a number of potential consumers of such products.

On the point of such flexible terms being included within the SMTA, and the fact that so much of the SMTA content remains to be negotiated between the parties, Wilke has expressed the view that having the WHO Secretariat lead on such negotiations may actually lead to a more equitable and effective outcome for developing states

> Unlike before the PIP Framework, when negotiations were conducted on a bilateral basis (often involving developing countries), it is the WHO that negotiates the final SMTA which introduce further checks and balances, thereby increasing the effectiveness, and more importantly, the equity.[33]

The extent to which these compromises in the wording of the standardised SMTA, along with flexibilities in the donations of vaccines provisions in the PIP Framework, will have an impact on procurement of PIV by developing states is explored more fully later in this paper. Prior to considering the content of the SMTAs that have been concluded between the WHO and PIV manufacturers, it is necessary to note the low take-up of these agreements amongst PIV manufacturers, as the number of manufacturers with an SMTA will clearly impact upon the effectiveness of the PIP stockpile as a procurement method for developing states.

SMTA uptake amongst manufactures

In the most recent review of PIV manufacturing capacity, Partridge & Kieny (on behalf of the WHO) identified twenty-four manufacturers that are active in manufacturing pandemic influenza vaccines[34]. In addition to this categorisation of influenza manufacturers, the WHO, when calculating partnership contributions for the running costs of GISRS[35], identifies those influenza vaccine, diagnostic and pharmaceutical manufacturers using the WHO-GISRS, in order for them to contribute to the running costs.[36] Of those manufacturers identified by Partridge & Kieny, eighteen also make partnership contributions to the WHO, on the basis that they use the WHO-GISRS[37]. Yet, despite the fact that eighteen active PIV manufactures have been identified as having benefited from the work of GISRS, only nine of these manufacturers have an SMTA in place.

Prior to the implementation of the PIP Framework Kamradt-Scott & Lee expressed concern that requiring PIV manufacturers to make partnership contributions for the running costs of GISRS could have the unintended consequence of forcing vaccine manufacturers out of the market, and thereby reducing the overall global vaccine capacity

> The imposition of what effectively equates to user fees for pharmaceutical companies that access GISRS data and samples, either through directly funding the network or via commitments to provide at least 10 per cent of vaccines and diagnostics at reduced prices, raises the possibility that some manufacturers will exit what has traditionally been a low-profit industry.[38]

Whilst it does not appear that manufacturers are actively leaving the market in order to avoid making contributions to GISRS as Kamradt-Scott & Lee feared, the fact that so few PIV manufacturers have concluded an SMTA appears to suggest that the majority believe they can continue PIV production whilst operating outside of the PIP Framework. Presumably this would be achieved by concluding bilateral agreements with states that have relevant viral samples in their territory, in a similar fashion to the Indonesia-Baxter agreement.[39] Indeed, nothing within the PIP Framework prevents states from transferring viral samples to GISRS via an SMTA, and concluding a bilateral agreement with a PIV manufacturer that operates outside of GISRS. It has further been noted that ‘A few manufacturers are using genetic

sequence data to make vaccines and other influenza related products[40]', a trend that allows manufacturers to make use of data generated via the WHO-GISRS network[41] but not require access to the viral samples. This would allow them to easily operate within the PIV market without being party to an SMTA. This trend is 'anticipated to increase' amongst PIV manufacturers, due to the anticipated increase in the use of generic sequence data in pandemic influenza research and development.[42] Both of these factors are particularly concerning from a procurement of PIV perspective as manufacturers, by avoiding the need to conclude an SMTA in order to gain viral samples, also avoid any obligations to contribute to the PIP stockpile, which will reduce as a direct consequence.

SMTA commitments by manufacturers

With regard to the PIV manufacturers that have concluded an SMTA, the WHO uses a formula based upon the average annual influenza product sales per manufacturer, for the three past years, plus the most recent pandemic year when determining contributions towards the running costs of GISRS.[43] Therefore, the greater the manufacturing capacity in the area of influenza vaccines, the higher the partnership contribution costs to be paid for using the GISRS system. As the below table indicates, three of the five largest pandemic influenza vaccine manufactures are party to an SMTA with the WHO, with the remaining six manufacturers that have an SMTA in place being small-to-medium sized manufacturers. The fact that the WHO has managed to successfully negotiate SMTAs with these nine manufacturers is clearly a positive step. However, the commitments which the WHO has managed to secure, along with the relatively low uptake amongst PIV manufacturers which contribute to GISRS, remain concerning. Despite the fact that the standardised SMTA provided at Annex 2 provides that manufacturers of vaccines in receipt of viral samples from WHO-GISRS should "donate at least 10% of real time pandemic vaccine production to WHO"[44], only the SMTA agreed with Novartis has met this 10% donation commitment. The remaining manufacturers have committed to donate between 7.5-9% of their real-time pandemic influenza manufacturing capacity in the event of a pandemic. Equally, the expectation was that PIV manufacturers would also commit to "Reserve at least 10% of real time pandemic vaccine production at affordable prices to WHO"[45]. However, no

manufacturer has committed to reserve 10% of real time production for purchase at affordable prices by WHO. The majority of signed agreements have a commitment of around 2%, with the one outlier being Sanofi Pasteur, with a purchase commitment of 7.5%.

Table 1: SMTA commitments by pandemic influenza vaccine manufacturers

Manufacturer	Partership Contribu-tion (USD)	SMT A in place?	Donation Commit-ment (%)	Purchase Commit-ment (%)
F. Hoffmann-La Roche Ltd.	6,158,153	no	-	-
GlaxoSmithKline	6,158,153	yes	7.5	2.5
Sanofi Pasteur	6,158,153	yes	7.5	7.5
Novartis	2,799,160	yes	10	2.5
BioCSL Pty Ltd.	979,790	no	-	-
BIKEN	699,790	yes	8	2
The Chemo-Sero-Therapeutic Re-search Institute (Kaketsuken)	699,790	no	-	-
Denka-Seiken Co., Ltd.	475,857	no	-	-
Kitasato Daiichi Sankyo Vaccine Co. Ltd. Medicago	335,899	yes	8	2
Green Cross Corp.	335,879	no	-	-
China National Biotech Group Co. Ltd.	307,908	yes	8	2
Sinovac Biotech Co. Ltd.	139,958	yes	8	2
Becton, Dickinson & Company	83,975	no	-	-
Fluart Innovative Vaccines Ltd.	83,925	no	-	-
Alere Inc.	39,071	no	-	-
Focus Diagnostic	30,791	no	-	-
Saint-Petersburg Scientific Research Institute of Vaccines and Sera	30,791	no	-	-
Cepheid	2,799	no	-	-
InDevr	2,799	no	-	-
Institute of Vaccine and Medical Bio-logicals	2,799	no	-	-

Table 1: SMTA commitments by pandemic influenza vaccine manufacturers

Manufacturer	Partership Contribu-tion (USD)	SMT A in place?	Donation Commit-ment (%)	Purchase Commit-ment (%)
MedImmune (AstraZeneca) Nano-sphere, Inc.	2,799	yes	9	1
Princeton BioMeditech Corporation	2,799	no	-	-
Protein Sciences	2,799	no	-	-
PT BioFarma	2,799	no	-	-
Qiagen	2,799	no	-	-
Quidel	2,799	no	-	-
Response Biomedical Corp	2,799	no	-	-
Serum Institute of India	2,799	yes	8	2
Takeda Pharmaceuticals Int.	2,799	no	-	-
The Government Pharmaceutical Or-ganization (GPO)	2,799	no	-	-
UMN Pharma	2,799	no	-	-
Vabiotech	2,799	no	-	-
Zydus Cadila Healthcare Ltd.	2,769	no	-	-

** This table was generated by cross-referencing the Agreements signed with manufacturers of vaccines and/or antivirals (available at http://www.who.int/influenza/pip/benefit_sharing/SMTA2_catA/en/) with the list of active pandemic vaccine manufacturers that make PIP Partnership Contributions to the WHO for using the WHO-GISRS network (available at: https://extranet.who.int/pip-pc-implementation/budget.aspx?year=2012)*

Such reductions in the obligations placed upon manufacturers that have SMTAs with the WHO, both in terms of donations and reserving doses for purchase at affordable prices by the WHO, significantly reduces the vaccination coverage within developing states using the stockpile as a procurement method. Despite this, the current PIP stockpile has approximately 230 million doses committed to it by way of donation.[46] This is clearly an improvement on the stockpile the WHO managed during 2009-H1N1, which distributed 78 million doses to ninety-seven developing states that were considered to lack the ability to purchase vaccine on

the commercial market.[47] However, not all of the doses in the PIP stockpile are reserved specifically for developing states that are unable to procure PIV on the open market, as was the case with the 2009-H1N1 donations. The PIP Framework mandates that donated vaccine will be distributed according to the following proportions

> One-third 'for use in affected countries, according to public health risk and need, to assist in containing the first outbreak or outbreaks of an emerging pandemic', two-thirds to 'developing countries that have no or inadequate access to H5N1 influenza vaccines, on a per capita basis, with use to be determined by those countries.[48]

There will of course be some overlap between these two groups where an affected country in an outbreak will also be a developing country with no or inadequate access to vaccines. However, assuming that two-thirds of this Stockpile is reserved for 'developing states in need' the stockpile could ensure a vaccination level coverage of 4.14% in developing states on a one-dose strategy, and 2.07% on a two-dose strategy, typical of influenza pandemics. Both of these are significantly below the target of 33% needed to establish herd immunity within a population. While the PIP Stockpile was not explicitly created with the 33% vaccination target in mind (nowhere in the drafting or the final text was a vaccination coverage target set) a minimum vaccination coverage of at least 33% has been required in all previous pandemics in order to establish herd immunity.[49] In relation to this target, clearly, the commitments provided in the example SMTA do not make procurement from the PIP stockpile a particularly attractive procurement option for developing states, particularly if it is seeking to procure sufficient vaccine to establish herd immunity levels within their territory.

When comparing procurement of PIV from the PIP stockpile, with the procurement of PIV from the Vaccine Deployment Initiative stockpile the WHO created during 2009-H1N1, it is clear that the one major benefit of the PIP stockpile is the potential removal of the time delay of donated vaccine being transferred to the WHO, and onwards to recipient states.[50] Despite this apparent benefit, concern has been expressed by the industry that during an influenza pandemic, member states with domestic PIV production within their territory would place restrictions upon exports of PIV that have been committed to the PIP stockpile, until domestic demand had been fulfilled.[51] This concern appears to be well founded, many developing states procured less vaccine, and procured it later, than their developed neighbours during

2009-H1N1.[52] One reason noted for this was that governments of developed states with domestic manufacturing capacity (that would have benefited from virus sharing by developing states) restricted exports to other territories until domestic demand had been fulfilled.[53] As Fidler noted

> Canada awarded its vaccine contract to a Canadian company because it feared that foreign governments might restrict exports to Canada because of vaccine shortages within their territories. The Australian government made it clear to the Australian manufacturer CSL that it must fulfil the government's domestic needs before exporting vaccine to the United States. The United States [stated that the US] would not donate H1N1 vaccine as promised until all at risk Americans had access, because production problems had created shortages in the United States.[54]

While the WHO Director-General is seeking periodic assurances from Member States that they would enable companies to fulfil their SMTA commitments to supply pandemic vaccine to WHO on a real-time basis,[55] it is not yet apparent if these assurances will be given by member states, or indeed, even if they are given, whether they will be honoured during a future pandemic. The Director-General appears keen to obtain such assurances as the problem of governments of developed states with domestic manufacturing capacity being able to prevent the export of PIVs to the WHO or developing states until domestic demand has been satisfied has not been resolved by the PIP Framework. Article 14 of the SMTAs signed with PIV manufacturers states that 'no Party shall be liable for any delay in the performance of or failure to perform its obligations under this Agreement, where such a delay or failure is caused by Force Majeure',[56] and the definition provided for 'Force Majeure' includes '….embargo or requisition' and 'acts of government.'[57]This means that the PIP Framework does not prevent the nationalisation of pandemic influenza vaccination manufacturing, or the embargo or requisition of vaccinations by states with domestic manufacturing in their territory. Such an embargo or requisition would have a significant impact on the viability of the PIP Stockpile by reducing the number of vaccines the Stockpile has to distribute, or by causing a significant delay in the delivery of the vaccines to the Stockpile, and onward transfer to recipient states. This suggests that it is unlikely that the PIP Framework will have, in practice, a significant positive impact on the procurement of

pandemic influenza vaccines by developing states, or indeed, that the Framework has done anything to change the status quo that exists between developed and developing states during an influenza pandemic.

The low uptake of SMTAs amongst PIV manufacturers, combined with the reduced commitments being given by PIV manufacturers in those SMTAs that have been concluded, make the PIP stockpile a particularly undesirable procurement method for developing states. Moreover, even when all of the vaccine that has been committed to the WHO via SMTAs has been delivered, it is likely that the WHO will need to seek donations from PIV manufacturers (outside of SMTA commitments) and developed states, in order to be able to fulfil the procurement needs of developing states (in much the same way they did during 2009-H1N1). This is a particularly undesirable scenario because, when making appeals for donated vaccine the WHO will again have 'little leverage to influence developed countries [and PIV manufacturers] other than rhetoric about equity, justice, and solidarity'[58]. If the WHO must again make appeals to equity and justice in order to procure vaccine to donate to developing states, as appears likely, it will highlight the significant shortcomings in the PIP Framework, which was designed specifically to minimise such a scenario during a pandemic.

This section has demonstrated that direct procurement from the PIP stockpile is not a viable option for developing states seeking to increase their access to pandemic influenza vaccines. Whilst procurement from the PIP Stockpile does have one distinct benefit: if developing states were to procure vaccines from the PIP Stockpile, then these vaccines ought to be distributed within the same timeframe as developed states, providing no embargo or requisition occurs.[59]

In addition to creating a stockpile for direct procurement, the PIP Framework also attempts to increase the transfer of technology from established PIV manufacturers in developed states, to new manufacturers in developing states. Transfer of technology, if properly managed, can also improve the procurement of pandemic influenza vaccines by developing states. Transfer of technology can create a situation whereby developing states are able to contract with pandemic influenza vaccine manufacturers based in their own territory, as opposed to being

reliant upon the established manufacturers based in developed states. This would allow developing states to have rapid access to pandemic influenza vaccines, and would eliminate the risk of developed states with pandemic influenza vaccine manufacturers based in their territory restricting exports of vaccines until domestic demand has been fulfilled during a pandemic.

Transfer of technology and vaccine procurement

The importance of developing states having some degree of self-sufficiency in pandemic influenza vaccine procurement, by contracting with pandemic influenza vaccine manufacturers based in their own territory, as opposed to being reliant upon the established manufacturers based in developed states, was highlighted by Friede et al, who noted that

> In 2006, 90% of influenza vaccine production was located in nine countries (largely in Europe and North America) that represented only 10% of the global population. Other countries, notably those in Africa, the Middle East and Asia, could witness a staggering death toll and a severe strain on their health services while waiting for producing countries and regions to have vaccinated their own populations.[60]

While pandemic influenza vaccine manufacturing capacity has increased since 2006, the proportions by which this capacity is divided between developing and developed states has remained largely the same, with capacity in developing states still being significantly lower than that which is required in order to adequately immunise their populations.[61] Therefore there is a clear need for developing states, either standing alone or as part of regional groups, to move towards self-sufficient procurement ofPIVs. In order to do so, manufacturers based in developing states require access to specific technical knowledge that cannot be inferred from the patent, and is not available in the public domain, in order to manufacture a PIV. In the case of these vaccines, it has been noted that

> [t]he technical know-how − even of conventional egg-derived influenza vaccines − is not readily found outside existing influenza vaccine production plants. Thus, even for procedures for which there are no patents, securing working partnerships with technology holders may be necessary.[62]

Without access to such technical knowledge, developing states, or manufacturers in developing states, are unable to manufacture their own vaccine as a method of procurement. Transfer of technology leading to increased self-procurement from domestic manufacturers is arguably the most effective manner by which developing states can sustainably and effectively procure sufficient doses of pandemic influenza vaccines, in an appropriate timeframe, during a pandemic.

To this end, at a policy level, the WHO has often encouraged transfer of technology from established manufacturers of pandemic influenza vaccines to new manufacturers in developing states, in order to improve pandemic preparedness within developing states. In the wake of growing concerns over the H5N1 strain of pandemic influenza in late 2005, the World Health Assembly passed Resolution WHA58.5, which focused upon strengthening pandemic influenza preparedness and response[63]. Resolution WHA58.5 required the Director-General to

> continue to develop WHOs plans and capacity to respond to an influenza pandemic, to be able to provide technical support, capacity building and technology transfer related to H5N1 influenza vaccines and diagnostics to developing countries.[64]

While not specifically related to pandemic influenza vaccines, the next major policy development at the WHO regarding transfer of technology in order to improve access to and the procurement of medicines was the Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property (GSPA-PHI) in 2008. The GSPA-PHI was ‘designed to promote innovation, build capacity [and] improve access to medicines,[65] and aimed to ‘promote new thinking on innovation and access to medicine’, as well as ‘provide a medium term framework for securing an enhanced and sustainable basis for needs driven essential health research and development relevant to diseases which disproportionally affect developing countries’.[66]

In relation to PIVs, this policy of promoting technology transfer to developing state manufacturers was largely facilitated though the WHO Influenza Vaccine Technology Transfer Initiative, a collaborative project between the WHO, some developed states and PIV manufacturers. The Influenza Vaccine Technology Transfer Initiative aimed to create regionally based, independent, and sustainable pandemic influenza vaccine production capacity in developing countries, through financial support and technology transfer to manufacturers in developing states.[67] Transfer of technology through the Influenza Vaccine Technology Transfer Initiative was facilitated through the creation of a 'hub' for the transfer of influenza vaccine technology. The Hub is a platform for transferring a complete manufacturing process at 'pilot scale' to a new manufacturer in a developing state by granting a non-exclusive license for use of the technology, along with providing information and training on using the technology, along with relevant safety and efficacy data, which allows the recipient to make use of a shortened regulatory pathway for licensing the PIV.[68]

The WHO Hub was launched in 2007 and, to date, vaccine manufacturers in seventeen developing states have received financial grants, and technical knowledge and understanding from the hub, which has enabled them to produce pandemic influenza vaccine.[69] Despite this success, it is reported that the WHO is concerned that 'there is a great lack of interested technology providers' wishing to contribute to the Hub[70]; meaning that the Hub is limited in the amount, or level, of technology available to it to be transferred. The role of the technology provider is obviously key to the success of the hub model, as the 'model can only be used with vaccines for which no intellectual property barriers exist in both the country hosting the hub and the country receiving the technology'.[71] Therefore the active engagement of the technology holder to grant a license that effectively removes these barriers in host and reciprocal states, as well as providing the technology and know-how, is key to the success of the hub model. The result of this lack of interest from technology providers to provide new and updated technology to the hub is that recipient manufacturers are unlikely to benefit from any of the scientific advances which occur in the field of pandemic influenza vaccines. The impact of this is that the pandemic influenza vaccines produced by recipient manufactures will not be as effective, or produced in as efficient a manner, as the vaccine produced by established manufacturers in developed states.

Transfer of technology provisions and the PIP Framework

One of the most notable omissions from the SMTAs that have been signed with PIV manufacturers is that none of the agreements currently in place has secured any commitments from manufacturers regarding technology transfer.[72] This is despite the fact that during the negotiations of the PIP Framework, the importance of transfer of technology for pandemic preparedness and procurement was stressed in the reports of the Advisory Group on Pandemic influenza at the WHO and the WHO Director-General, which were integral to the development of the Framework. The Director-General noted that: 'Preparedness requires long-term investment, particularly when capacity building requires training and transfer of knowledge,'[73] whereas the Group stressed the need to achieve the greatest impact by building capacity in states where it is lowest and observed that preparedness requires long-term investment, particularly when capacity building requires training and transfer of knowledge[74].

Facilitating the transfer of technology from established PIV manufacturers to manufacturers in developing states is one of the clear aims of the PIP Framework. Paragraph 6.0.2(iv) states that 'the PIP Benefit Sharing System will operate to: build capacity in receiving countries over time for and through technical assistance and transfer of technology, skills and know-how and expanded influenza vaccine production, tailored to their public health risk and needs'[75]. Further detail on the WHO's vision for transfer of technology via PIP is provided at 4.6.1-4.6.2, which states that

> The Director-General will continue to work closely with Member States and influenza vaccine manufacturers to implement the WHO Global Pandemic Influenza Action Plan to Increase Vaccine Supply, including its strategies to build new production facilities in developing and/or industrialized countries and through transfer of technology, skills and know-how.
>
> Member States should urge influenza vaccine, diagnostic and pharmaceutical manufacturers to make specific efforts to transfer these technologies to other countries, particularly developing countries, as appropriate.

> Influenza vaccine manufacturers who receive PIP biological materials may grant, subject to any existing licensing restrictions, on mutually agreed terms, a non-exclusive, royalty-free license to any influenza vaccine manufacturer from a developing country, to use its intellectual property and other protected substances, products, technology, know-how, information and knowledge used in the process of influenza vaccine development and production, in particular for pre-pandemic and pandemic vaccines for use in agreed developing countries.[76]

It is clear that the WHO views increasing transfer of technology as an integral part of the plan to increase access to pandemic influenza vaccines and reduce the inequality between developing and developed states on this issue, therefore it is necessary to determine to what extent transfer of technology provisions have been incorporated into the PIP Framework. This is particularly relevant as the PIP Framework represents an ideal opportunity to increase transfer of technology to developing states manufacturers. However, despite the clear impetus within the WHO, both at a policy level, and in the development of the PIP Framework, the resulting obligations which were placed upon manufacturers in regard to transfer of technology via the PIP Framework appear particularly weak.

Within the 'Obligations of the Company' in the standardised SMTA provided in the Annex of the PIP Framework , the transfer of technology related provisions state that manufacturers of vaccines and/or antivirals can commit to

> A5. Grant to manufacturers in developing countries licenses on mutually agreed terms that should be fair and reasonable including in respect of affordable royalties, taking into account development levels in the country of end use of the products, on technology, know-how, products and processes for which it holds IPR for the production of (i) influenza vaccines, (ii) adjuvants, (iii) antivirals and/or (iv) diagnostics[77]

and/or:

> A6. Grant royalty-free licenses to manufacturers in developing countries or grant to WHO royalty-free, non-exclusive licenses on IPR, which can be sublicensed, for the production of pandemic influenza vaccines, adjuvants, antivirals products and diagnostics needed in a pandemic. WHO may sublicense these licenses to manufacturers in developing countries on appropriate terms and conditions and in accordance with sound public health principles.[78]

There is a number of elements concerned with transfer of technology within these SMTA that are particularly concerning. Firstly, there is no link between the work of the WHO Influenza Vaccine Hub, and the PIP Framework. While Paragraph A.6 does provide the technology holder with the option to grant royalty-free, non-exclusive licenses on intellectual property rights to the WHO, who can then sublicensed these rights to manufacturers in developing states, it makes no reference to the transfer of technical knowhow required to work the invention covered by these intellectual property rights also being transferred to the WHO. This is concerning because it is not merely the intellectual property rights which pose a significant barrier to developing states being able to establish pandemic influenza vaccine manufacturing in their territory. While intellectual property rights *can* be a barrier to manufacturers in developing states establishing manufacturing capacity, it is the lack of technical knowhow amongst prospective manufacturers in developing states that has clearly been identified as the barrier to self-sufficient procurement of pandemic influenza vaccines by developing states.[79]

Instead, PIV manufacturers that choose to engage with transfer of technology as part of their 'Company Obligations' are compelled only to transfer technology to a non-specific number of manufacturers in developing states, meaning the knowledge will only be transferred to a limited number of entities, at the technology holder's discretion on a bilateral basis. Technology transfer which occurs on a bilateral basis between an established manufacturer acting as donor to a new manufacturer in a developing state has been noted as being 'not readily feasible in cases where there is limited financial benefit for donor' in the context of pandemic influenza vaccines.[80] Therefore it is particularly concerning that this is the only transfer of technology option which is available as an 'Obligation of the Company' within an

SMTA. Transfer of technology via the PIP Framework could have had significantly greater impact if the technology holder were compelled to transfer their knowledge to the WHO Influenza Vaccine Hub, along with the right for the hub to transfer this knowledge on again, to multiple relevant manufacturers in developing states. This would ensure maximum distribution of relevant technical knowledge, which in turn would help build pandemic preparedness by increasing vaccine manufacturing capacity in developing states.

In addition to the above, the wording in each of the transfer of technology provisions in the SMTA provisions is too vague. As noted above, if transfer of technology is to occur on a bilateral basis from one manufacturer to another, this will only occur when it is financially viable for the donor. The wording of paragraph A.5 specifies neither the number of recipient manufacturers, not the number of recipient developing states that are to receive transferred technology in order to comply with the obligation. This is seemingly left to the PIV manufacturer transferring the technology to decide. Moreover, the wording 'terms that should be fair and reasonable' is again particularly subjective, with both 'fair' and 'reasonable' not being defined within the Framework, again, leaving it open to the interpretation of donor manufacturers. The vague wording of the transfer of technology related provisions within the SMTAs, particularly in relation to key terms, will inevitably lead to inconsistencies in the amount of technology transfer that will occur, and the terms of the transfer. This may lead to donor manufacturers determining that 'fair' and 'reasonable' has a particularly low threshold, and therefore, they are only obliged to undertake minimal transfer in order to meet this requirement. Whilst it may be the case that some particularly benevolent manufacturer will transfer more technology than is deemed 'fair' or 'reasonable' to a state, this will lead to an inequitable situation whereby some developing states have benefited significantly more than other recipient states.

Transfer of technology from an established pandemic influenza vaccine manufacturer to a new manufacturer in a developing state has been encouraged by the WHO through its policy initiatives, on the basis that it is not intellectual property rights but access to knowledge that constitutes the most significant barrier for new manufacturers to begin pandemic influenza vaccine production. To this end, the WHO has seen some limited success in transferring

technology related to the pandemic influenza vaccine manufacturing process from established manufacturers, to new ones. Despite this, none of the pandemic influenza vaccine manufacturers that have an SMTA in force has committed to transfer technology to the WHO as part of its company obligations. However, even if any manufacturer had committed to this, the transfer of technology related provisions contained within the Framework are too weak to have any real positive impact on the manner in which developing states can establish influenza vaccine manufacturing capacity within their territory, in order to achieve sufficient access to vaccine during a pandemic. This is a key failing of the Framework, as it is this ability to establish manufacturing capacity which looks to be the most suitable method to provide developing states with a sustainable and effective method of pandemic influenza vaccine procurement. Transfer of technology, along with the removal of intellectual property related barriers to production, is key to this being possible.

Conclusion

Prior to SMTAs being concluded with PIV manufacturers the academic commentary on the PIP Framework was, despite some noted criticism, generally positive. In particular, the Framework was hailed as being an innovative model mechanism for guaranteeing access to vaccines and affordable life-saving drugs.[81] However, having considered the SMTAs concluded between the WHO and pandemic influenza vaccine manufacturers, this paper has argued that such praise appears to be misplaced. Indeed the PIP Framework does provide one clear benefit to developing states that procure from it, in that those states that procure vaccine from the PIP Framework ought to procure them in the same timeframe as self-procuring developed states. However, it is clear that the Framework does not provide an appropriate tool by which developing states could procure enough vaccines to meet their public health needs.

Three predominant reasons for this can be identified. First, the provisions within the example Standard Material Transfer Agreement provided at the annex to the PIP Framework, fail to maximise benefit sharing for developing states, largely due to the overly flexible benefit sharing obligations secured in the PIP Framework, and the lack of compulsion requiring

relevant PIV manufacturers to commit to benefit sharing via a SMTA. Second, the prospect of developing states using the PIP Stockpile as a procurement tool becomes even less viable when the SMTAs that pandemic influenza vaccine manufacturers have signed are taken into consideration. Too few of the pandemic influenza vaccine manufacturers currently active within the market have committed to share benefits with the WHO via an SMTA. This clearly impacts undesirably on the number of doses which the PIP Stockpile has available to it for distribution to developing states that have been unable to procure vaccine via self-procurement methods. Finally, the viability of the PIP Stockpile as a procurement method is further reduced when the terms which have been secured with the nine manufacturers that are party to a SMTA are evaluated.

Whilst the PIP Framework already contains provisions intended to improve technology transfer from technology holders to developing states wishing to be in receipt of said technology via SMTA2 Agreements, there is little incentive for technology holders to engage with SMTA2 generally, and even less incentive to engage with the specific transfer of technology provisions within the SMTAs. In respect of future reforms, it would be beneficial if the WHO placed great emphasis on facilitating transfer of technology and knowhow from vaccine manufacturers, to developing states, in order for developing states to become less reliant upon procurement from established pandemic influenza vaccine manufacturers in developed states, or receiving donations from the WHO - as these are demonstrably not viable options for developing states. Future reform of the PIP Framework ought to strive to make a more innovative access and benefit system sharing system which directly links PIV manufacturers' access to viral samples via the PIP Framework with compulsory transfer of technology provisions. These reforms should focus on resolving the identified limitations of the PIP Framework in respect of transfer of technology, namely: that there is at present little incentive for technology holders to engage with SMTA2 generally, and even less incentive to engage with the specific transfer of technology provisions within the SMTAs; transfer of technology occurs bilaterally between states leading to inconsistencies in technology implementation; and there is no link between the work of the WHO Influenza Vaccine Hub, and the PIP Framework.

[1] The Lancet, 'Global Solidarity Needed in Preparing for Pandemic Influenza' (2007) 369(9561) The Lancet 532; Arthur L. Caplan and David R. Curry, 'Leveraging Genetic Resources or Moral Blackmail? Indonesia and Avian Flu Virus Sample Sharing' (2007) 7(11) The American Journal of Bioethics 1; Kenan Mullins, 'Playing Chicken with Bird Flu: 'Viral Sovereignty,' the Right to Exploit Natural Genetic Resources, and the Potential Human Rights Ramifications' (2009) 25 American University International Law Review 943; Sedyaningsih and others, (n26); Tadataka Yamada, 'Poverty, Wealth, and Access to Pandemic Influenza Vaccines' (2009) 361(12) New England Journal of Medicine 1129; Stephan Elbe, 'Haggling over viruses: the downside risks of securitizing infectious disease' (2010) 25(6) Health Policy and Planning 476; ES Ng and PA Tambyah, 'The ethics of responding to a novel pandemic' (2011) 40(1) Annals of the Academy of Medicine, Singapore. 30

[2] Since its inception the WHO has played a major role in the management of pandemic influenza outbreaks, even going as far as to procure vaccines, and distribute them to developing states that lack access during a pandemic, though this has been done on a largely ad-hoc basis. WHO, 'Main operational lessons learnt from the WHO pandemic influenza A(H1N1) vaccine deployment initiative' (2011) <http://www.who.int/influenza_vaccines_plan/resources/h1n1_vaccine_deployment_initiaitve_moll.pdf>; (accessed 14 June 2016);

[3] Peter Gelling, 'Indonesia defiant on refusal to share bird flu samples' *New York Times* (26 March 2015) <http://www.nytimes.com/2007/03/26/world/asia/26cnd-flu.html?_r=0>; WHO, 'Sharing of avian influenza viruses and pandemic vaccine production' (*WHO*, 8 December 2010) <http://www.who.int/mediacentre/news/statements/2007/s02/en/>

[4] Rachel Irwin, 'Indonesia, H5N1, and Global Health Diplomacy'' (2010) 3 Global Health Governance

[5] WHO, 'Interim statement of the intergovernmental meeting on pandemic influenza preparedness: Sharing of influenza viruses and access to vaccine and other benefits' (WHO) <http://apps.who.int/gb/pip/pdf_files/IGM_PIP-IntStatement-en.pdf>

[6] Mark Turner, 'Vaccine procurement during an influenza pandemic and the role of Advance Purchase Agreements: Lessons from 2009-H1N1' *Global Public Health Journal* 9(1) (2015) P.1

[7] Jeffrey Partridge and Marie Paule Kieny, 'Global production of seasonal and pandemic (H1N1) influenza vaccines in 2009–2010 and comparison with previous estimates and global action plan targets' (2010) 28(30) Vaccine 4709

[8] Kenneth A. McLean, Shoshanna Goldin, Claudia Nannei, Erin Sparrow, and Guido Torelli, 'The 2015 global production capacity of seasonal and pandemic influenza vaccine' (2016) 34(45) Vaccine 5410

[9] McLean, '2015 global production capacity'

[10] It was subsequently acknowledged by the WHO Intergovernmental Meeting on Pandemic Influenza Preparedness that the pre-PIP system did not deliver fairness, transparency or equity to developing states, and disproportionately benefited developed states with their own vaccine manufacturing base, by allowing easy access to viral samples with which to develop a vaccine with no clear obligations to share the benefits - WHO, 'Interim statement of the intergovernmental meeting on pandemic influenza preparedness: Sharing of influenza viruses and access to vaccine and other benefits' (WHO) <http://apps.who.int/gb/pip/pdf_files/IGM_PIP-IntStatement-en.pdf>

[11] WHO, 'Resolution WHA 60.28, Sixtieth World Health Assembly, Seventh Plenary Meeting', (2007).

[12] Ibid, 2(3)

[13] 'GISRS means the international network of influenza laboratories, coordinated by WHO, that conduct year-round surveillance of influenza, assessing the risk of pandemic influenza and assisting in preparedness measures. The WHO GISRS comprises National Influenza Centres, WHO Collaborating Centres on Influenza, WHO H5 Reference Laboratories and Essential Regulatory Laboratories' – definition provided at 4.3, WHO, Pandemic Influenza Preparedness Framework For The Sharing Of Influenza Viruses And Access To Vaccines And Other Benefits (2011)

[14] Article 1(9), PIP Framework these benefits, are considered in more detail later in this paper

[15] WHA, 'Resolution WHA60.28: Pandemic Influenza Preparedness: Sharing Of Influenza Viruses And Access To Vaccines And Other Benefits' (2007) http://apps.who.int/gb/ebwha/pdf_files/WHASSA_WHA60-Rec1/E/reso-60-en.pdf (accessed 22 May 2016)

[16] Turner, 'Vaccine'

[17] Standard Material Transfer Agreements is the method by which the WHO enters into agreements with entities outside the WHO GISRS, such as pharmaceutical companies that manufacture pandemic influenza related products such as vaccines or antivirals. SMTA2's have provisions related to benefit sharing included within them.

[18] See for example the example SMTA2 provided at: Annex 2, SMTA2, Article 4.4.1.A, PIP Framework

[19] David Fidler and Lawrence Gostin, 'The WHO pandemic influenza preparedness framework: A milestone in global governance for health' *JAMA* 306(2)200 (2011); Nicole Franklin, 'Sovereignty and International Politics in the Negotiation of the Avian Influenza Material Transfer Agreement' *Journal of law & Medicine* 17(3) (2009); Nicole Jefferies, 'Levelling the playing field? Sharing of influenza viruses and access to vaccines and other benefits' *Journal Of Law and Medicine* 20(1) (2012) P.59; Simone Vezzani, 'Preliminary Remarks on the Envisaged World Health Organization Pandemic Influenza Preparedness Framework for the Sharing of Viruses and Access to Vaccines and Other Benefits' *The Journal of World Intellectual Property* 13(6) (2010) P.675; Alexandra Phelan and Lawrence Gostin, 'Farewell to the God of Plague: Has International Law Prepared Us for the Next Pandemic?' *Georgetown Journal of International Affairs* xv(2) (2014) P.134;

[20] Vezzani, 'Preliminary'

[21] 6.9.2, PIP Framework

[22] For more information on Advance Purchase Agreements, and the impact they have on procurement of pandemic influenza vaccines see: Turner, 'Vaccine'

[23] Turner, 'Vaccine'

[24] WHO, 'Guidance On Development And Implementation Of A National Deployment And Vaccination Plan For Pandemic Influenza Vaccines' (WHO 2012) <http://apps.who.int/iris/bitstream/10665/75246/1/9789241503990_eng.pdf?ua=1> 3 (accessed 22 may 2016)

[25] Fidler and Gostin, 'Milestone'

[26] For the purposes of the Framework the terms PIP Biological Materials 'includes human clinical specimens, virus isolates of wild type human H5N1 and other influenza viruses with human pandemic potential; and modified viruses prepared from…influenza viruses with human pandemic potential developed by WHO GISRS laboratories, these being candidate vaccine viruses generated by reverse genetics and/or high growth re-assortment… [and]… RNA extracted from wild-type H5N1 and other human influenza viruses with human pandemic potential and cDNA that encompass the entire coding region of one or more viral genes. 4.1 PIP Framework; These material are important as, in order to manufacture a pandemic influenza vaccine, the vaccine preparation must contain an element of the inactivated virus against which the vaccine inoculates: Catherine Gerdil, 'The Annual Production Cycle For Influenza Vaccine' *Vaccine* 21(16) (2003) P.1776

[27] Annex 2, SMTA2, Article 4.4.1.A, PIP Framework

[28] Jefferies, 'Levelling'; Vezzani, 'Preliminary'; Phelan and Gostin, 'Farewell'

[29] Footnote 1, Annex 2, SMTA2, Article 4.1.A PIP Framework

[30] WHO, 'Chair's text – Draft – Pandemic Influenza Preparedness Framework for the Sharing of Influenza Viruses and Access to Vaccines and Other Benefits' (WHO 2008) <http://apps.who.int/gb/pip/pdf_files/PIP_IGM_WG_6Add1-en.pdf> 1.1 (accessed 25 May 2016)

[31] Articles 5, 6, and 9-13 , Annex 2, SMTA2, PIP Framework

[32] ‘The complex and time-consuming work to negotiate and conclude SMTA2s as well as the lack of resources – both human and financial – to scale up the pace of negotiations’ was noted by the Pandemic Influenza Preparedness Framework Advisory Group, in May 2013. At this time One SMTA2 has been concluded with GSK, and negotiations were underway with Baxter, China National Biotec Group and the Serum Institute of India, and pre-negotiation discussions were on-going with Sanofi and Novartis. Currently only two of these negotiations and pre-negotiations have led to an SMTA2 being concluded (Sanofi and the Serum Institute) WHO, 'Pandemic Influenza Preparedness: Sharing Of Influenza Viruses And Access To Vaccines And Other Benefits Report Of The Meeting Of The Pandemic Influenza Preparedness Framework Advisory Group Report by the Director-General' (WHO 2013) <http://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_17-en.pdf> Add.1 (accessed 3 June 2016)

[33] Marie Wilke, 'The World Health Organization’s Pandemic Influenza Preparedness Framework as a Public Health Resource Pool' in Evanson Chege Kamau and gerd Winter, eds., *Common Pools of Genetic Resources: Equity and Innovation in International Biodiversity Law* (London, Routledge, 2013)

[34] Jeffrey Partridge and Marie Paule Kieny, 'Global production capacity of seasonal influenza vaccine in 2011' *Vaccine* 31(5) (2013) P.728

[35] All vaccine, diagnostic and pharmaceutical manufacturers that use the WHO-GISRS system (Use of GISRS’ is understood to include receipt of physical materials, or use of data and/or information, some of which may not be routinely provided to the general public) are under an obligation to make an annual partnership contribution to WHO contributing an amount equivalent to 50% of the operational costs of GISRS.- WHO, ‘Pandemic Influenza Preparedness: Sharing Of Influenza Viruses And Access To Vaccines And Other Benefits Report By The Director-General' (WHO 2016) http://apps.who.int/gb/ebwha/pdf_files/WHA69/A69_22-en.pdf (accessed 22 May 2016)

[36] 6.14.3, PIP Framework

[37] This figure was reached by cross-referencing the list provided in Partridge and Kieny ‘2011’ at Footnote.1 and WHO, '2013 PIP Partnership Contribution (PC) Collection: Results as of 1 August 2014’ (WHO 2014) <http://www.who.int/influenza/pip/benefit_sharing/2013_pc_collection_results_1aug2014.pdf?ua=1> Table.1. (accessed 22 March 2016)

[38] Adam Kamradt-Scott and Kelley Lee, 'The 2011 Pandemic Influenza Preparedness Framework: Global Health Secured or a Missed Opportunity?' *Political Studies* 59(4) (2011) P.831

[39] During a period of not sharing viral samples with GISRS during 2005-H1N1 the Indonesian government entered into negotiations with Baxter International to develop a vaccine based on samples provided by Indonesia. The parties reached a Memorandum of Understanding that ‘provide[d] a framework for future discussions and negotiations related to any formal collaboration or supply agreements for pandemic vaccine’. These discussions eventually broke down, and Indonesia returned to consistently sharing viral samples with GISRS in mid-2007. See: David Fidler, 'Negotiating Equitable Access to Influenza Vaccines: Global Health Diplomacy and the Controversies Surrounding Avian Influenza H5N1 and Pandemic Influenza H1N1' *PLoS Medicine* 7(5) (2010) e1000247.

[40] WHO, ‘Pandemic influenza preparedness: sharing of influenza viruses and access to vaccines and other benefits Report of the meeting of the Pandemic Influenza Preparedness Framework Advisory Group Report by the Director-General’ (WHO 2013) <http://www.who.int/influenza/pip/A66_17Add1-en.pdf> (accessed 22 May 2016) P.4

[41] Op. cit., P.4

[42] Op. cit., P.4

[43] Op. cit., P.4

[44] Annex 2, SMTA2, Article 4.1.A.1, PIP Framework

[45] Annex 2, SMTA2, Article 4.1.A.2, PIP Framework

[46] Margaret Chan, ‘Post-ebola reforms deserve support’ *British Medical Journal (Online)* 356 (2017)

[47] WHO, 'Report Of The WHO Pandemic Influenza A(H1N1) Vaccine Deployment Initiative (VDI)' (WHO 2012) <http://www.who.int/influenza_vaccines_plan/resources/h1n1_deployment_report.pdf> (accessed 3 May 2016) 3.1

[48] PIP Framework, 6.9.2

[49] Pedro Plans-Rubió, 'The Vaccination Coverage Required To Establish Herd Immunity Against Influenza Viruses' *Preventive Medicine* 55(1) (2012) P.72

[50] As was noted in Turner, 'Vaccine' vaccine committed to the VDI stockpile by industry and developed states arrived in recipient developing states at least four months later than in self-procuring states.

[51] WHO, 'VDI' 20

[52] Turner, 'Vaccine'

[53] Fidler, 'Negotiating'; Sam F Halabi, 'Multipolarity, Intellectual Property, and the Internationalization of Public Health Law' *Michigan Journal Of International Law* 35 P.714

[54] Fidler, 'Negotiating'

[55] WHO, 'Meeting Of The Pandemic Influenza Preparedness (PIP) Framework Advisory Group 21-24 October 2014, Geneva, Switzerland: Report to the Director-General' (WHO 2014) http://www.who.int/influenza/pip/pip_ag_oct2014_meetingreport_final_7nov2014.pdf (accessed 3 May 2016)

[56] Article 14, GSK-WHO, 'SMTA2'; Article 14, Serum Institute of India-WHO, 'SMTA2'; Article 14, Sanofi-WHO, 'SMTA2'

[57] Article 3, GSK-WHO, 'SMTA2'; Article 3, Serum Institute of India-WHO, 'SMTA2'; Article 3, Sanofi-WHO, 'SMTA2'

[58] Fidler, 'Negotiating'

[59] Providing none of the developed states in whose territory the manufacturing facilities are based place restrictions on the exports of pandemic influenza vaccines until domestic demands have been fulfilled. As noted above this is a very real possibility in the event of a severe pandemic.

[60] M Friede et al, 'WHO Initiative to Increase Global and Equitable Access to Influenza Vaccine in The Event of a Pandemic: Supporting Developing Country Production Capacity Through Technology Transfer' *Vaccine* 29-Suppl.1 (2011) A2

[61] Jeffrey Partridge and Marie Paule Kieny, 'Global Production of Seasonal and Pandemic (H1N1) Influenza Vaccines in 2009–2010 and Comparison with Previous Estimates and Global Action Plan Targets' *Vaccine* 28(3)0)(2010) P.4709; Partridge and Kieny, '2011'

[62] WHO, 'Global Pandemic Influenza Action Plan To Increase Vaccine Supply: Progress Report 2006–2008' (WHO/IVB/09.05 2009) <http://apps.who.int/iris/bitstream/10665/70018/1/WHO_IVB_09.05_eng.pdf> (accessed 3 May 2016) 33

[63] World Health Assembly, 'Resolution 58.5, Fifty-Eighth World Health Assembly' (2005)

[64] Op. cit., 2(7)

[65] WHO, *Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property* (WHO, 2011) http://www.who.int/phi/publications/Global_Strategy_Plan_Action.pdf (accessed 15 May 2016) at 'Aims'.

[66] Op. cit., Article 13.

[67] For more information on the work of the WHO Influenza Vaccine Technology Transfer Initiative see: WHO, 'Report of the second WHO consultation on the global action plan for influenza vaccines (GAP)' (WHO, 2012) <http://apps.who.int/iris/bitstream/10665/44794/1/9789241564410_eng.pdf> (accessed 15 May 2016) 2.2.2

[68] Friede, 'Initiative'

[69] G Torelli, 'WHO Technology Transfer Initiative: Progress Update (8th meeting with international partners on prospects for influenza vaccine technology transfer to developing country vaccine manufacturers)' (WHO 2015) <http://www.who.int/phi/DAY1_02_Torelli_PM_SaoPaulo2015.pdf > (accessed 15 May 2016)

[70] Reported at: Claire Boog, 'Institute for Translational Vaccinology One health and global health developments within Intravacc' (2013) http://aighd.org/media/medialibrary/2013/06/Boog-One_Health_and_Global_Health_developments_within_Intravacc.pdf (accessed 11 May 2016)

[71] Sara Eve Crager, 'Improving Global Access to New Vaccines: Intellectual Property, Technology Transfer, and Regulatory Pathways' *American Journal of Public Health* 104(11) (2014)

[72] GSK-WHO, 'SMTA2';Serum Institute of India-WHO, 'SMTA2'; Sanofi-WHO, 'SMTA2'

[73] WHO, 'Pandemic Influenza Preparedness: Sharing Of Influenza Viruses And Access To Vaccines And Other Benefits: Report Of The Advisory Group Report By The Director-General' (WHO 2012) http://www.who.int/influenza/pip/A65_19_en.pdf (accessed 15 May 2016)

[74]Op. cit.,

[75] 6.0.2(IV), PIP Framework

[76] 6.13.1-4, PIP Framework

[77] Annex 2, SMTA2, Article 4.4.1.A5, PIP Framework

[78] Annex 2, SMTA2, Article 4.4.1.A6, Op. cit.,

[79] WHO, 'Mapping of Intellectual Property Related to the production of Pandemic Influenza Vaccines' (WHO, 2007) http://www.who.int/vaccine_research/diseases/influenza/Mapping_Intellectual_Property_Pandemic_Influenza_Vaccines.pdf, (accessed 22 May 2016).

[80] Friede, 'Initiative'

[81] Jefferies, 'Levelling'; Fidler and Gostin, 'Milestone'; Vezzani, 'Preliminary'