



# Global Consultation on Diagnostics Interoperability Standards



11-12 June 2015  
Geneva, Switzerland



**World Health  
Organization**

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## ACKNOWLEDGEMENTS

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## LIST OF ACRONYMS

AMC	Advance market commitment
AMR	Antimicrobial resistance
ANDI	African Network for Drugs and Diagnostics Innovation
AST	Antimicrobial susceptibility testing
ASSURED	A system of WHO for rapid diagnostic testing
BoP	Bottom of the pyramid
CDC	US Centers for Disease Control
CLSI	Clinical and Laboratory Standards Institute
COGS	Cost of Goods Sold
CMO	Contract manufacturing organization
CMPT	Clinical microbiology proficiency testing
CSR	Corporate social responsibility
DARPA	Defense Advanced Research Projects Agency
DOD	United States Department of Defense
DX	Diagnostics
FDA	US Federal Drug Administration
FDC	Fixed dose combination
EHR	Electronic health record
EMR	Electronic medical record
EQAP	WHO External Quality Assessment Project (EQAP)
EUCAST	European Committee on Antimicrobial Susceptibility Testing
ID	Infectious disease
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IHE	Integrating the Healthcare Enterprise
IICC	IVD Industry Connectivity Consortium
IMDRF	International Medical Device Regulators Forum
IP	Intellectual property
ISO	International Organization for Standardization
IVD	In vitro diagnostics
GAP	Global Action Plan
HCAI	Healthcare-associated infection
HCV	Hepatitis C virus
HIV	Human immunodeficiency virus

HL7	Health Level Seven International
HPV	Human papilloma virus
LMIC(s)	Lower- and middle-income country/countries
MOH(s)	Ministry/ministries of health
MRSA	Methicillin-resistant staphylococcus aureus
NAAT(s)	Nucleic acid amplification test(s)
NCD(s)	Non-communicable disease(s)
NGO(s)	Non-governmental organization(s)
NLM	US National Library of Medicine
NSB(s)	National standards body/bodies
OEM	Original Equipment Manufacturer
OS	Operating system
PCR	Polymerase chain reaction
POC	Point of care
POCCIC	Point of Care Connectivity Industry Consortium
PrEP	Pre-exposure prophylaxis
QA	Quality assurance
R&D	Research and development
RDT	Rapid diagnostic test
ROI	Return on investment
SDO(s)	Standards development organization(s)
SIHI	Social Innovation in Health Initiative
SOP(s)	Standard operating procedure(s)
SME(s)	Small- and medium-sized enterprise(s)
TB	Tuberculosis
TDR	Special Programme for Research and Training in Tropical Diseases (WHO)
TPP	Target product profile
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children’s Fund
WHA	World Health Assembly
WHO	World Health Organization
WIPO	World Intellectual Property Organization



## EXECUTIVE SUMMARY

As a first step toward the development of multipurpose point-of-care diagnostic platform, a global consultation on diagnostics interoperability standards took place in Geneva in June 2015, building on earlier work from a number of other stakeholder organizations. Two sets of standards were considered: device-to-device; and device connectivity. The consultation also included a discussion on new business models and financial incentives for the diagnostic industry to develop and introduce open diagnostic platforms in lower- and middle-income countries based on such standards.

The consultation considered input from all stakeholders—appropriate experts, representatives of user groups, international organizations and industry. Consensus emerged that discussion should continue on business models and interoperability standards, both with regard to connectivity and physical interfaces.

It was agreed that three working groups should be formed:

1. A group on connectivity interoperability standards, tasked to make specific recommendations by the end of November 2015, taking into account the many standards already existing and how to build on these.
2. A group on interoperability standards for physical interfaces, with the same task and schedule.
3. A group on business models, tasked with examining the many existing possibilities and making specific recommendations, with the same schedule.

It was concluded that these groups should present concrete proposals at a meeting to be organized in December 2015.

In the short term, the WHO steering committee for the diagnostics project would work out the details of how to run these groups, and address the task of facilitating the creation of an industry consortium to complement their work.

## NOTE TO THE READER

Because of the rich discussion and in an attempt to keep this report simple and readable, comments are not attributed unless their content renders attribution necessary.

This report condenses the themes of each session – including the interventions from the floor – according to the themes addressed, rather than attempting to provide a chronological summary of the dialogue.

## BACKGROUND

### **The need for low-cost and robust point-of-care diagnostics**

Diagnostics are critical for successful delivery of healthcare; conducting routine public health surveillance; rapid detection and containment of infectious diseases; responding to health emergencies; dealing with the growing problem of antimicrobial resistance; and detecting and managing non-communicable diseases.

In particular, in order rapidly to detect and respond to a new disease outbreak, it is essential to have diagnostic tests at point-of-care (POC). Diagnostic tests that are only available in central health facilities require samples to be transported, which delays the detection of potential outbreaks and can also compromise the integrity of samples.

Moreover, diagnostic tests which are used in central facilities are often too complex, difficult to use and costly for remote POC locations, particularly in lower- and middle-income countries (LMICs). For this reason, diagnostics suitable for POC use must be developed that combine adequate sensitivity and specificity with general characteristics such as low cost and low power consumption (or battery operation), a lack of requirement for expensive consumables, minimum waste generation, simplicity of use, robustness, usability without need for substantial training, and resistance to heat and humidity.

Diagnostics that meet these requirements have been or are being developed for a number of diseases and health conditions. A good example is that of the numerous POC rapid diagnostic tests (RDTs) developed for malaria, which are now playing a major role in malaria control; but affordable and appropriate diagnostics are still needed for many other diseases. In addition, such diagnostics are also needed to determine whether infections are viral or bacterial; to identify strains; to determine drug resistance; and to respond rapidly to disease outbreaks. Affordable and appropriate diagnostics are also needed to deal with the rapidly growing problem of non-communicable diseases in LMICs.

As new diagnostics become available, local health care centres in LMICs struggle to procure and maintain all the different diagnostic tests and associated equipment required to diagnose and monitor the large number of diseases and health conditions affecting the people attending these health care centres. It must also be emphasized that having a multitude of different tests and equipment in a facility requires local health care workers to be trained to use all these different devices.

In addition, the results and interpretation of POC diagnostic tests need to be captured in the medical records including electronic medical records (EMR) and health records (EHR).

This creates the need to align POC diagnostic tests standards with the health information technology standards used in EHR, EMR and other information and communication technology (ICT) products, including mobile applications.

For all these reasons there is a need for a new approach for diagnostics in local health care centres in LMICs. Low-cost, robust and multipurpose point-of-care diagnostic devices capable of data exchange with EHR and other health information technology (HIT) could provide one solution to these problems.

Devices displaying the following characteristics are likely to have the strongest impact:

- Portability, with battery or low power consumption capability
- Ability to utilize variety of sample types and less sample preparation
- Adequate sensitivity/specificity to avoid high incidence of false negatives/false positives
- Capable of performing multiplex assays
- Able to perform both nucleic acid and protein assays
- Low cost
- Able to function above 30°C and at high humidity
- Without need for refrigeration for cartridges/reagents
- Use of solid phase or dry reagents that can be reconstituted at POC
- Reagents with demonstrated stability for long shelf life
- Ability to function in the absence of reliable electricity infrastructure
- Robustness: no need for maintenance and spare parts
- Simplicity of use for local health care workers (very few steps to perform the tests)
- Minimal training requirements
- Modular format: for example, with a choice of cartridges for different diseases or health conditions
- Open platform to allow easy test addition and partnering opportunities
- Based on voluntary international industry standards
  - for design, performance, user interface and quality
  - for data exchange
- Ability to display results clearly on equipment and transmit them wirelessly.

In order to develop such diagnostic devices, it is critical to determine which sets of standards should be developed and adopted by the various stakeholders involved, and in particular by the diagnostic industry.

## The need for diagnostic standards

In the “plug and play” world of consumer electronics, consumer demand for simple and seamless functionality and affordability has led to a few common standardized interfaces and platforms, which in turn have led to the high interoperability now seen in consumer electronics. Standards for greater interoperability of diagnostics could be developed in order to achieve the same benefits. Diagnostics interoperability in this context refers both to information sharing between the platforms and cartridges and to data exchange between the platforms and patient-data systems such as Electronic Health Records (EHRs), Laboratory Information Management Systems (LIMS) and other HIT applications.

Such standards for interoperability would in principle lead to many benefits for the providers, the users and the diagnostics industry. The main benefits would be as follows:

### *Device to device interoperability standards*

- Promotion of lower overall diagnostics costs:
  - One reader/transmitter could be used with multiple cartridges from different suppliers, requiring less equipment
  - Only the tests required at each POC location need be stocked
  - Reduced need for redundant equipment and associated parts and maintenance
  - Reduced training requirements, improving quality and reducing costs
  - Use of the same equipment for several diseases and conditions, maximizing return on investment.
- Device operating parameters (for use at POC in LMICs) included as part of specifications of device to device standards will facilitate the development of diagnostics suitable for these settings.
- Open platforms would allow for easy test addition and partnering opportunities.
- Lower entry barriers to market participation, in particular for smaller companies.
- The standards would also guide the design and development of new products—as has been the case with USB and wireless communication standards in the computer industry, which has allowed small companies to develop and bring new technologies rapidly to market, fuelling innovation and competition.
- Accelerated diffusion of technology.

### *Device to electronic health records interoperability standards*

- Improved timeliness, accuracy and completeness of diagnostic data
- Improved clinical decision support using the means of health information systems, leading to improved (effective and efficient) patient care and safety.

- Improved electronic capabilities for reporting of notifiable conditions to national and international authorities.

### **The need for new business models and new financial incentives**

Initial feedback from diagnostic companies and other stakeholders clearly suggests that the development and introduction in LMICs of new open diagnostic platforms based on interoperability standards cannot utilize existing business models.

Although many multinational diagnostic companies based in high income countries expect to find most of their future growth in emerging economies, the approach of simply applying their domestic models to emerging markets is limiting them to selling in the highest income tiers, which in most emerging markets are not big enough to generate sufficient returns. This issue is not specific to diagnostics but also applies to drugs, vaccines and other medical devices, and is therefore now the subject of numerous debates within the global health community in general, and within WHO in particular.

Fundamentally new models must therefore be devised for in vitro diagnostics (IVDs) appropriate for LMICs. This consultation was planned to discuss new business models and financial incentives that could facilitate both the research and development (R&D) and the introduction of such platforms in LMICs in a sustainable manner, and which would attract the diagnostic industry. New approaches are required to leveraging financial resources, building expertise, and developing new partnerships among the main diagnostics stakeholders—which the organizers hope will be one of the important outcomes of this project.

WHO believes that diagnostic companies willing to explore new business models and partnerships to address the diagnostic needs in LMICs will see significant opportunities for growth, while providing a great public health service where it is the most needed.

### **Objectives of the consultation**

The initial objectives of this project are to define what types of interoperability standards would facilitate the development of new POC diagnostics for LMICs, and whether the diagnostics industry would agree to adopt these standards.

To achieve these objectives, a global consultation on diagnostics standards was organized building on earlier work from organizations such as the Bill and Melinda Gates Foundation, ISO, CLSI, the Integrating the Health Care Enterprise (IHE), the Medical Device “Plug-and-Play” (MD PnP) Interoperability Program, the Continua Health Alliance and other organizations working on increasing interoperability of medical devices. Two sets of standards were considered: device-to-device; and device (interface) to electronic health records (connectivity).

The consultation also included a discussion on new business models and financial incentives for the diagnostic industry to develop and introduce open diagnostic platforms in LMICs based on the agreed interoperability standards.

According to WHO practices, an important consideration was to ensure global representation of appropriate experts and representatives of user groups while minimizing conflicts of interests. The diagnostic industry was also consulted.

### **Expected outcomes of the consultation**

1. Agreement between major diagnostics stakeholders on the desirability of diagnostics interoperability standards and on new business models to facilitate the development of low cost, robust, multipurpose POC diagnostics devices for LMICs; and initiation of a 5-year plan to develop such platforms
2. Agreement to conducted the following activities in parallel between July and December 2015, with the contribution of all the diagnostic stakeholders:
  - a. Creation of a working group to identify each interoperability standards that needs to be developed/adopted
  - b. Creation of a working group to propose and develop new business models for supporting industry in implementing new multipurpose (open) POC diagnostic platforms for local health care centres in LMICs.
  - c. Creation of an open consortium, including diagnostics companies and other relevant stakeholders, to develop new diagnostic platforms based on agreed standards and new business models.



## INTRODUCTION AND PRESENTATION OF OBJECTIVES

**Dr Francis Moussy**, *Diagnostic Innovation, Essential Medicines and Health Products Department, World Health Organization*

Dr Moussy welcomed the participants to the consultation, setting the scene with a short presentation outlining the increasing need for point-of-care (POC) diagnostics, particularly in lower- and middle-income countries (LMICs), where the need is greatest and solutions are lacking for many diseases. He also provided an overview of the current state of interoperability between systems, and sketched out expected outcomes of the consultation.

Dr Moussy pointed out that the potential for progress is good: many new diagnostics are currently being developed, and new technologies are constantly coming online. In the context, diagnostic interoperability standards and new business models together constitute the first step towards developing the necessary platforms.

The particularities of the LMIC context mean that a new approach to diagnostics is required: new platforms for use at POC will have to be low-cost, robust, open with a focus on interoperability so that they are able to use instruments and cartridges from different manufacturers, and simple enough to use with minimal training. He envisioned local health care centres equipped with one or two platforms used for diagnosis and treatment monitoring for infectious and non-communicable diseases and surveillance purposes. Such technology would necessitate instruments with different cartridges for different diseases or conditions that are easy to use, suitable for multiplexing, and which provide result readouts and transmit them wirelessly.

This meeting, he said, constituted the first step toward the development of such a platform. The first day would cover the types of standards needed; the second would cover the business models and necessary incentives for industry. Providing the meeting with definitions of interoperability standards, he summarized the consultation's goal as:

- To achieve agreement between major diagnostics stakeholders on the desirability of diagnostics interoperability standards
- To achieve the same on new business models to facilitate the development of low cost, robust and multipurpose POC diagnostics for LMICs
- The initiation of five year plan to achieve this.

Dr Moussy then proposed that, subject to participants' agreement, further work would follow the meeting: working groups would be created to identify the necessary standards and consider new business models. Then, a stakeholder consortium would be established to develop new platforms based on agreed standards and business models.

Dr Moussy then introduced Mr Jean-François de Lavison, who would moderate the meeting.

***Mr Jean-François de Lavison, Ahimsa Partners SAS***

Mr de Lavison opened with a statement of confidence that the meeting would reach agreement. Stressing the importance of gathering stakeholders around the table, he thanked all those who had travelled to participate, singling out representatives of the Gates Foundation for particular thanks for all the related work they have already done and their input during the preparation of this consultation.

He then outlined the aspects of the meeting to come and covered relevant logistical issues, before introducing the first speaker.

## SESSION 1: CAN WE LEARN FROM OTHER INDUSTRIES TO FACILITATE THE DEVELOPMENT OF INTEROPERABILITY STANDARDS FOR DIAGNOSTICS?

### *How interoperability standards may shape the landscape for emerging diagnostic technologies*

**Dr Jennifer Nuzzo**, UPMC Center for Health Security

Dr Nuzzo provided an outline of the global diagnostics market, which she described as large, but with POC diagnostics comprising only a small part. She argued for a strategic need to develop infectious disease diagnostics, and identified issues with budgets and incentives, and particularly with how to create those incentives in a time of strained resources. Standards, she proposed, can be used to do this. She outlined the potential value of standards and argued that they can lead to increased innovation and adoption.

Dr Nuzzo suggested five major categories for diagnostics standards: performance; user interface; interoperability (on which this meeting was focused); regulatory; and analytic. Several technical approaches could be taken, she argued: a platform could be created allowing companies to develop consumables, or vice versa, and a combined approach is also possible. A key issue, she suggested was incentivisation. Incentives for **uptake** could include reduced costs, improved quality control, and streamlined maintenance; while incentives for **development** of these systems could come from network effects. The possible downside of this was the potential for lock-in, which can impede innovation – as exemplified by the QWERTY keyboard, a standard originally introduced to slow down mechanical typists.

While making standards open source can help through inspiring competition, it does not always lead to greater uptake, innovation and access, and “the problem with a platform that is ‘too open’ is that other market participants will inevitably start to produce what amount to generic consumables... this takes the margin that your company could be realizing, and potentially degrades your devices’ performance. These are powerful disincentives to product standardization.” Dr Nuzzo gave the example of Linux, which while open source does not enjoy a large share of the desktop operating system marketplace.

#### **Discussion**

A question and answer session followed. It was noted that while Linux does not dominate the client desktop computer space, it is used widely on almost all routers, in smart TV technology, on smartphones and in cars, and elsewhere; and that in terms of server space it has a huge footprint. Ergo it is not an example of failure. The point was however noted that while open source standards do not automatically take over the

marketplace, they do serve important functions: with regard to the QWERTY example it was also argued that while it is not the most efficient standard it cannot be considered a failure because the marketplace has adapted to it; and the fact that a standard exists has helped promote typing. This discussion does, however, raise questions about how technology evolves: care must be taken to create systems that can accept change.

Given the large number of parameters applicable to this field, it was also noted that any standard under discussion must include technical and business issues: if the desired goal is a diagnostics platform allowing small companies to participate, it is essential that business issues are taken into account.

One speaker observed that the particular demands of LMICs had to be noted explicitly in any discussion of POC diagnostics, arguing that in parts of Africa the distance from POC to the nearest hospital or laboratory might be 60 miles, accessible only by plane or a days travel in a 4x4 in conditions making it unlikely any sample would survive the journey. Context must also be taken into account when looking at funding: if the money for development is not available then the incentives for business are crucially important.

The question of liability, which would become a recurring theme, was raised with regard to responsibility for occasions when something goes wrong.

### *Interplay between patents & standards*

**Dr Marco Aleman**, *Acting Director, Patent Law Section, Patent Law Division, World Intellectual Property Organization (WIPO)*

Dr Aleman outlined the main features of patent laws from the perspective of WIPO, explaining some of the subtleties of how patents work. There are differences between the objectives of patents and standards: standards ensure interoperability, quality, safety and reliability, while the main role of patents is to promote innovation. There is also tension between the two systems in that patents are designed to ensure exclusive use of a given technology by the patentee, while standards set out to encourage wide implementation within a given industry.

He further outlined and explained several potential conflicts between patents and standards, including (i) patent ambush, where information is withheld in the patent process; (ii) royalty stacking, where a standard privileges those who have already adopted or created the included technology; and (iii) patent hold-up, caused when participants in a given standard incur considerable expenses for the use thereof. Current approaches to resolving these issues include on one hand the improvement of standard setting organizations' self-regulatory mechanisms in order to increase

transparency and accessibility to patented technologies; and on the other, legislative measures either in the field of patents or external to the patent system.

Dr Aleman concluded by pointing out that intellectual property (IP) is not a principal difficulty in the process of standardization—although dealing properly with IP policies beforehand will certainly help, and having an alternative dispute resolution process in place is an important way of avoiding difficulties. IP is an important part of the standards discussion and remains—and should remain—an area for further analysis within these discussions.

## Discussion

In the diagnostics context, communications and software systems raise discussions about the role of patents that may not be applicable to pharmaceuticals in general. Tensions will certainly come, and in this case may be around the increased number of patents available; IP has to be an element in the consultation if it is to arrive at the right conclusions.

The point was made that the IP policy of the Institute of Electrical and Electronics Engineers (IEEE) sets an example for the health domain, making it harder to any one contributing a standard essential patent to secure an injunction worldwide.

## *ITU and standards development*

**Mr Simão Campos**, *Counsellor, ITU-T Study Group 16 on Multimedia*

Mr Campos introduced the three sectors of the International Telecommunication Union (ITU): radiocommunication; telecommunication standardisation and telecommunication development. The ITU is funded by membership fee from member states, sector members and associates, and is the only intergovernmental organization where the private sector participates under its own name and in its own right. Private ITU members have a right to participate in and submit proposals to the working groups with which they're associated; indeed ITU's standardisation work is 95% driven by private sector members, a unique feature of the organization when compared to other UN organizations. Furthermore, ITU recognizes the importance of working in partnership, collaborating with other standards development organizations (SDOs) and "all parts of the industry".

Mr Campos outlined the bottom-up process of developing a standard, which is focussed on the technical merits of the proposals. In ITU, standards are developed by consensus rather than by vote, because interoperability is important in the telecommunication and ICT field. The consensus-building process can take from a few weeks to 2-3 years to complete, depending on complexity and maturity of the project and the scope of the

matter under discussion. It incorporates private sector input, discussion, and a search for common ground before the initiation of a set approval process. Once the development is done, it takes ITU on average 9 1/2 weeks from the start of the approval process to send the standard for publication. Standardisation, Mr Campos emphasised, is neither an easy process nor a cheap one; so it is advisable to build as much as possible on pre-existing work.

Mr Campos offered ITU-T H.810 (2013), which ensures interoperability of devices used for applications monitoring personal health, as a good example of a standard developed to build a platform accommodating a wide range of technologies, approaches, and stakeholders. He believed this architecture might be a good starting point for diagnostics standards interoperable at interface level. Mr Campos finished by offering ITU's support for the diagnostics project.

## Discussion

Once the challenges of agreeing a standard are overcome, a trusted product will have to be developed, and there are challenges there too: the health care environment requires products not just to claim compatibility but in fact to be reliably and unceasingly interoperable and interchangeable. This is not just a regulatory issue, but also one pertaining to the utility and interchangeability of tools. Conformity testing is key to this, whether private, public or open, and must be covered by the discussions. Mr Campos noted that there is an extensive set of conformity testing developed for ITU-T H.810, and agreed that the same should be developed for any diagnostics standard.

Mr Campos was asked whether ITU often had to deal with a “what’s in it for me” attitude from its private members. Normally, he responded, private companies have a well-developed business case before they come to the table and know precisely what they want to be part of a standard, and the areas where they can accept compromise for the sake of consensus. For example, those looking to develop services are often not trying to derive revenue from intellectual property rights (IPRs), because they intend to sell services; while for manufacturers and other technology players, IPRs may represent an important interest. In both cases, participants can build on networking effects to make value. In line with WTO principles, commercial aspects are not discussed in the ITU standardization context; this way, decisions are focused on technical merits—though politics can play a role.

The issue was raised of whether the consultation was considering *de facto* standardisation, where the discussion would gravitate to the best technology, or a *de jure* approach involving the imposition of standards. It was acknowledged that this is a complex area, in particular when IPRs are involved. Specifications in *de jure* standards do not designate or define a product, but rather a class of products with fixed

characteristics (e.g. a well-defined pre-determined set of parameters provided at an interface level). This approach avoids lock-in to a particular manufacturer, but requires robust conformity checking procedures to be put in place.



## SESSION 2: PREVIOUS AND CURRENT WORK ON DIAGNOSTIC INTEROPERABILITY STANDARDS

### *Gates Foundation point-of-care initiative: assessment of a single diagnostic standard approach for the developing world*

**Dr Jim Gallarda**, Senior Programme Officer, Diagnostics/Integrated Development, Bill & Melinda Gates Foundation

Dr Gallarda outlined the experience of the Gates Foundation, which has been working for several years on a Point of Care Initiative (POCI) assessing the feasibility of combining several distinct diagnostic analysers onto a universal open source instrument standard.

Although several global diagnostic companies focus largely on producing diagnostics solutions suitable for the developed world, there is recognition that a range of innovative ideas is needed, taking into account the unique needs of LMIC recipients. Grand Challenges in this area were sponsored, resulting in issuing of 23 grants that are, at time of writing, in various stages of completion.

POCI anticipates decentralised placement, with diagnostic analysis at the level of community health centres and clinics. Dr Gallarda ran through various POC platform options – open and closed – and a market analysis illustrating POCI's focus on open platforms accommodating multiple tests and technologies. He also outlined the partner landscape, mapping global in vitro diagnostic players and their respective roles in the development process—underlining the importance of understanding the particular and unique needs of LMICs as well as the complexity of implementation and scale up.

Among many diagnostic test developers, few have deep understanding of the patient pathway and the broader healthcare ecosystems found in LMICs. “Fitting” a pre-existing product originally designed for the developed world into the intended use environment of a developing country carries its own risks. Even with the development of a highly accurate diagnostic product, the realities within the country's healthcare system might preclude effective use of the test. Dr Gallarda argued, for example, that when faced with a sick child suffering from pneumonia, a health care worker at community level might not use such a test (which comes with a cost), and might instead opt for immediate empiric treatment with amoxicillin, regardless of whether the diagnostic test provided accurate information on the nature of the infection (e.g. whether it was bacterial or viral).

Over the course of the POCI program, Dr Gallarda related that some companies understandably questioned whether the timing is right for the development of such an open source, “one-box-does-it-all” concept, given the risks inherent in such a complex undertaking.

Dr Gallarda concluded that technical development of such open source solutions is not sufficient. The associated business models are equally important and must address the needs of both supply and demand stakeholders. For example, in typical proprietary or “closed” models, in vitro diagnostics (IVD) companies often rely on a “push” marketing strategy explaining the product’s features and benefits to potential customers. Effective “pull” strategies jointly involving payers and country decision makers must also be developed. In global health, such “pull” forces might come from clinical utility evidence derived from other external demand influencers such as the WHO and FIND.

Recognizing the need for ensuring healthy markets once such solutions are developed, the Foundation’s response has been to call for a “market manager” role—a function that might articulate both “push” and “pull” value propositions, addressing both demand and supply stakeholders. The ideal outcome here, Dr Gallarda suggested, was the kind of consumer “pull” demand force currently seen in Apple fans queuing for new iPhone releases. For an open source diagnostics platform, this might also be accomplished by establishing a supply/demand stakeholder consortium that not only accommodates current technologies, but which could also adapt to new future disruptive innovations with potential for local manufacturing of standardised products branded with “Proudly Made” in various regions.

## **Discussion**

It was pointed out that a platform that accepts different technologies requires compromise in performance of some assays, sometimes to a degree not acceptable to labs: it is impossible to have ‘best in class’ in everything. It is also unreasonable to expect great cost savings from a machine carrying out many different functions because the heart of the machine must incorporate all the necessary technologies.

A broader point was made with regard to long term cost saving: machines eventually become obsolete, and obsolescence can be hastened by changes in communications standards, operating systems, and the like. Dr Gallarda remained confident that from an innovator’s perspective these issues are solvable, though he conceded not easily so. As for future innovations, the supply/demand stakeholder consortium mentioned above could serve as an innovation in its own right, in that such an institution could develop rational procedures for the implementation of new technologies into LMICs.

In discussion of the business model it was observed that while the ‘pull’ strategy is familiar in the developed world, in LMIC contexts it faces many hurdles. Innovation is less common on the business side; but that is the purpose of this consultation, and several observers agreed that industry is more willing now to cooperate in this kind of approach than it has been in the past. While some large diagnostics companies are challenged by single-digit growth rates, the answer to that could lie in the 4.5 billion

people living in LMICs; so insights are required into business models that typical western companies don't consider, in order to be successful in these new markets.

### *(Semi-) open platform approach: enabling partnerships in IVD*

**Dr Jeroen Nieuwenhuis, Philips**

Forty per cent of Philips' turnover is already in healthcare: the majority is in vivo diagnostics but the company is developing a complete suite of in vitro solutions, working with the Gates Foundation on true POC molecular diagnostics. They have focussed on modular systems on the basis that a 'one box for everything' approach would offer insufficient flexibility for the diversity of use settings.

Dr Nieuwenhuis outlined existing IVD standards, pointing out that nearly all clinical IVD systems—machines and consumables—are completely closed, and summarised the pros and cons of other approaches. Life Sciences, he pointed out, offer some open systems (Luminex, for example) where parties can develop their own reagents; and in the wider world there are other examples of this approach, such as coffee capsules. Philips' approach to development takes in different modes of collaboration on semi-open platforms, and the company supports other parties to develop assays on the Philips system. Philips has different relationships with parties that have different requirements, providing them with greater or fewer services depending on their needs.

Dr Nieuwenhuis argued that the way data is managed is a crucial part of such systems. In this context he outlined Philips' Health Suite Digital Platform system to collect, process and distribute clinical data, and the necessary collaborations with others who use the system to carry confidential data.

A semi-open approach, he said, is the best way to get started; but it requires big investment and without an owner or another party making the first move it is difficult to get such solutions started. The best approach, therefore, is to get someone to kick off the systems side, so that others can then get to work on the IT and assay sides accordingly. After this is done, it is possible for the system to adapt to local needs in ways that are not necessarily possible for the company that starts the development process.

He then outlined key aspects of what a semi-open platform has to offer: a broad menu for the end user on a single instrument, with access to many novel/proprietary markers and an open market for assay development; controlled improvements extending the lifecycle of the POC platform; state of the art connectivity; a single point of contact for service and support; and attractive cartridge costs with scaling advantages obtained by larger volumes.

## Discussion

With regard to semantic interoperability, different standards exist, and accordingly a range of interfaces is available for Philips' machine. On the liability front, Dr Nieuwenhuis was asked about the process of development with partners, and how liability is assigned for the device, its safety and its performance. He responded that regulations stipulate that there must always be a registered developer for an assay; but liability depends on the relationship between the developer and user. Whoever makes the assays is the responsible manufacturer for that given case.

He was asked who owns the data generated on a platform solution; ownership, he said, is very specific to the application, country, setting and case. There is no universal answer: it depends what can be transferred and how it can be acceptably used. Development is a big effort: Philips has a team of 500 software developers working to build this IT backbone, and keeping it all in line with relevant regulations is a major task. This is a complicated field with a great number of regulatory hurdles and outcomes that can have direct impact on patients; so a high degree of control is required. In response platforms are often semi-open, and many start with a lead organization (Nespresso's work on the coffee capsule system is again the most accessible example).

### *The PanDx approach to cartridge interface standards*

**Mr Wallace White**, *Director, Point-of-Care Diagnostics, Stratos*

Stratos' experience is in point-of-care diagnostics; the small, Seattle-based company does not make products, but rather designs them and transfers those designs to clients. In 2011, Stratos was asked by the Gates Foundation to learn what should and could be done in LMICs in Latin America, Africa and India; the company spent time visiting clinics worldwide and learnt about context and challenges. The current state of the art is the use of different systems in a single lab, requiring several machines in a single bay, or even sometimes a separate outbuilding, along with the training and expense costs associated with numerous separate systems.

Stratos' response is the PanDx concept: a box with multiple slots that accommodates multiple tests. Its goals are ease of use; flexibility and modularity in order to increase capacity and vary test types, sample types and sample sizes; robustness; openness to other developers' tests; and a full menu of diagnostic uses. While today's state of the art is a series of closed platforms, Stratos' vision is a set interface for which companies can design their own instruments and build cartridges according to what they think is required, so that the user can mix and match.

The company has not yet built the box, but has created a ‘breadboard’ instrument that works exactly as production instrument would, though currently without the hood and using just a single slot. The goal to date has been to show the possibilities of the technology; not to present a completed product. Three types of demo cartridges exist (these are not yet at production standard but they demonstrate that the platform will work): a TB assay from sputum; an HIV assay from whole blood; and an ALT assay from whole blood. Cartridges—and White explained how each will work—are relatively cheap.

Technology is not the hardest part; rather, the challenge is one of trade-offs—can the tests be cheap enough? Will buyers understand the necessary trade-offs, for example that cheaper tests are possible on single-purpose systems? Can the system costs (training, support, space required) pay off?

### **Discussion**

With regard to bringing down cost, focus and effort so far has been on the cost of cartridges. The instrument is not cheap: a five-bay box costs around USD10k, roughly USD 2,000 per slot, and the dedicated computer on top about USD1,000. A 15-bay, three-stack system therefore costs around USD31k.

The best approach to development and delivery is not yet clear. Roles can be mapped out, but they come down to whether/how agreements can be brokered. Stratos has noted a strong desire worldwide for both instruments and devices to be fabricated in-country, accommodating many markets with different desires and needs. White argued that multinationals should be brought in to the process, but that this will raise the challenge of how it can be made to work with their business models.

Analysis is required of expected volumes per type of test, comparing the cost for buying separate instruments with that of having one instrument with different cartridges at different prices, and mapping the point where one becomes cheaper than the other.

### ***The GSID System: creating a universal reader at the point of care***

**Mr Ian Francis**, *Global Solutions for Infectious Diseases (GSID)*

GSID is a not-for-profit organization focused on the development of products to prevent and control infectious diseases. For this project, GSID sought use products already in the system rather than developing new diagnostic devices. Mr Francis outlined the rapid diagnostic tests already at global scale today which meet WHO’s ‘ASSURED’ criteria. ASSURED breaks down as follows:

- Affordable by those at risk of infection
- Sensitive (few false-negatives)
- Specific (few false-positive)
- User-friendly - simple to perform with minimal training
- Rapid and Robust
- Equipment-free
- Delivered to those who need it.

GSID's offering is a universal, interoperable wireless reader for lateral flow tests, using pre-existing rapid diagnostics tests and open source, user configurable software running on Android phones, thereby taking advantage of the solid Android platform and existing cellular networks.

Mr Francis outlined a proof of concept study in Zimbabwe that shed light on many of central issues in LMIC contexts: half the people using the device in the trial had never used a touchscreen device before.

GSID's vision is a system interoperable with all available tests, collecting all data and sharing all information with all the systems available to use it, and with the goal of real time global reporting of all infectious diseases; all this on a universal reader that works with any device at a very low cost and is fully interoperable with all systems and Android devices. Such data could then be used for a variety of processes, including surveillance, outbreak detection, quality assurance and electronic medical records

## **Discussion**

This reader is intended more to improve the real time accessibility of data than to offer any advantage for sensitivity. There was some discussion as to whether it was in fact technically a medical device—that is to say, a device allowing diagnostic decisions to be made based on its output, and as such subject to the manufacturer's regulatory environment. Decisions can be based on digital interpretations of its results, but Mr Francis clarified that if a user wanted to use it as a diagnostic tool, they would have to partner with a diagnostics company with regard to regulatory issues. There are, however, many other possible uses for such a device: Mr Francis explained how part of the system was designed to assist surveillance systems by establishing the baseline for diseases, then following up with targeted detailed assessments once disease interventions have been rolled out.

## **Standards Developing Organizations – perspectives on POCT standards**

**Dr Donald M Powers**, *Chairman, ISO/TC 212*

Dr Powers began by underlining the fact that there are many ways in which to accomplish the diagnostics objectives set out by WHO. In that context, he provided an overview of the relevant standards developing organizations (SDOs), such as CLSI, ISO/TC 212 and ISO/TC 215, and their activity to date in the POC space. He also mentioned the important role of related initiatives that are supporting standardization, such as the ITU, IEEE, the POC connectivity industry consortium (POCCIC), the IVD industry connectivity consortium (IICC), HL7, and Integrating the Healthcare Enterprise (IHE).

He then outlined the standardisation process and the POC standards currently in use, and noted that ISO/TC 212 is currently developing a standard for POCT in difficult environments in LMICs. For such a standardisation process to work, the following are required: market need; stakeholder support; well-defined design requirements; a realistic project plan; an IVD industry consortium providing technical experts; strong project leadership; and active feedback from stakeholders. A lot of typical mistakes are made in the standards development process: starting too early or too late; working in an adversarial environment; a lack of cohesion in project teams; gaps in technical expertise; and excessive focus on schedules.

Dr Powers then summarised the necessary next steps in scoping and developing the standard: determining whether a market need exists for the standard and confirming that sufficient stakeholder support is available; defining the type of standard and its specific requirements; choosing the most practical pathway; forming an industry-led open POCT consortium to agree on the best technical solutions; selecting and supporting a project leader and project team; and updating initial editions based on user experience. He particularly underlined the need for a champion to drive a standards project; continuation of the industry consortium after publication of the standard to promote its adoption; and recruitment of third party certification bodies to assess manufacturers' conformity to the standard.

### **Discussion**

It was pointed out that there are other organizations that contribute to the process—in particular IEEE, which has been active in supporting ISO/TC 215 in the development of medical device interoperability standards. It was also commented that a number of other standards will be applicable to the POCT device, and they will impact development because so many aspects of the device must eventually work together.

With regard to determining the market need for the standard, there was discussion of what kinds of tests will motivate the IVD manufacturers to participate. It was argued

that the business case is the most critical factor from the manufacturers' point of view; the market need for the standard naturally follows from the business case. There may also be political hurdles to overcome in some countries; for example, some European professional organizations are against allowing POC testing outside the control of a medical laboratory, which could influence the positions of their National Standards Bodies (NSBs).

### *Connectivity and E-health standards*

**Dr Catharina Boehme (CEO) and Mr Chris Isaacs** (*Senior Technology Officer eHealth*), *Foundation for Innovative New Diagnostics (FIND)*

FIND is a product development and delivery partnership “working towards a world where diagnosis guides the way towards health for all people.” Mr Isaacs outlined current issues related to connectivity in the standards space. Connectivity, he argued, often takes a low priority in the development cycle of a diagnostics device, though it should not: connectivity is an essential requirement of a diagnostics device.

While the idea of an open platform that can accommodate many tests is attractive, it can be seen as analogous TV box capable of receiving thousands of channels, when really only a handful are watched. It might, he argued, be a more elegant solution to add disease-specific packages to a baseline machine.

Obstacles to connectivity add cost, increase the need for operational support, and risk data loss; and none of this is helped by the fact that there are multiple standards. Mr Isaacs outlined why the key issues exist, arguing that most reasons are common sense—particularly the lack of use case definitions. There is a need for eHealth interoperability standards, but the question of who benefits is more complex than initially appears: there are multiple stakeholders, not all of which are immediately obvious.

Mr Isaacs outlined the work FIND has done with WHO so far, explaining the process of developing target product profiles (TPPs) for diagnostics, and sketching out the steps to come. His assessment of the state of the market, however, was an interesting one: “in my opinion we are still a bit too early with POC diagnostics to worry about standards... most people are concerned with having practical solutions available rather than worrying about which standards.” He also pointed out that worldwide efforts were not coordinated – on this particular day, he said, he knew of two other standards meetings taking place elsewhere in the world. In this context, he outlined what he felt was needed: a single standard developed by all stakeholders, underpinned by uniform use case definitions.

In the right settings, he concluded, standards can be used to accelerate emerging technology development. When applied too early in the technology development process, however, they may contribute to the stifling of innovation.

Standards are most effective when adopted voluntarily by the private sector when it sees clear benefit, and at a time of appropriate technological maturity; and there are possibly too many standardization efforts ongoing today for healthcare and diagnostics. This is causing confusion, delaying adoption and creating a negative effect.

Finally, whilst standards are emerging, in the meantime we must maintain momentum and focus on practical working solutions and the realization of benefits.

### **Discussion**

For reasons of time there was no discussion.



## SESSIONS 3 AND 4: **WORKING GROUP SESSIONS: ROLES, PROBLEMS AND SOLUTIONS OF INTEROPERABILITY STANDARDS**

*What role can interoperability standards play in catalyzing the development of new POC diagnostic tests? Which interoperability standards are needed? What are the obstacles to their development and use? What are the possible solutions?*

Throughout the day, participants had been encouraged to sign up to one of four different working groups for the afternoon sessions. After lunch, the groups were split up accordingly, with group 1—which was oversubscribed—separating into two groups, 1A and 1B.

In the day's closing session the participants reconvened and each group presented a summary of their discussions.

The groups were as follows.

### **Group 1A: Feedback from industry and NGOs**

**Moderator: Tala de los Santos, Director, Diagnostics, PATH**

While this group was exploring ideas rather than trying explicitly to reach conclusions, emergent themes of the discussion were as follows.

A lack of progress to date can be attributed to lack of funding, IP issues, liability, and poor financial incentives; and better understanding is required of the needs of developers and users. Open standards will facilitate collaborative approaches and more open business models, which can speed innovation; but industry is best at establishing standards.

Timing is crucial for standards development; and it could be that the industry is not currently ready to move on physical interoperability. Some participants argued that we should give up on trying to establish interoperability standards for now; in other words, they felt that the timing is not quite right yet. To enter low resource environments, the diagnostics industry still depends on donors and funders for product development and deployment. No fully self-sustaining business model (i.e. a model without donor involvement) currently exists. In this context, donors could drive or incentivize industry to develop standards.

Before any further work is done users must be asked what they think of interoperability standards—do they have opinions or see a need?

Security concerns exist about sharing data with companies, having data leave its country of origin, etc.; but for most users, having data available in the cloud is not really a

priority—they are more concerned with reliability, ease of use, and minimising training burdens. The most useful data standard would be one that facilitates sharing of data from a diagnostic device to the clinician who needs it. Companies, on the other hand, might find these standards useful in logistics and dealing with supply chain and stocking issues.

Since no business model exists to pull manufacturers into LMICs, payers and donors - global funds and big institutions - have a real opportunity to impose standards, thereby dictating to the companies who want to play in this field using donor money that they have to stick to ordained standards. Convening the power of donors offers many options in standards development; one speaker offered the example of grocery companies getting together to demand a united system from different bar code developers.

With regard to developing a business model, a semi open platform could be a good intermediate step, rather than giving up completely on the interoperability question. There may be good incentives for small- and medium-sized diagnostic companies to look at such a model, as it lowers some barriers to market entry. Even for the bigger companies, this model may present options as a risk mitigation strategy.

On the technical side, the experience of manufacturers suggests that it is hard to divorce development of assays from specific instrumentation. Maintenance is also an issue, and in LMIC contexts the consultation should consider a 'swap out' model of replacing faulty machines, rather than bringing service issues into the field.

## **Discussion**

All the actors paying for the diagnostics could be more proactive in the standards-setting process: not just donors, but also governments and anyone else involved in health care in both the global north and the global south. There can be problems here, because big organizations are not always aligned with the interests of users, but people need to look at how the standards process is governed and make it more open to those in public health. Public health stakeholders should have opportunities to organize and play a more positive role in the development process.

### ***Group 1B: feedback from industry and NGOs***

**Moderator: Jim Gallarda**, Senior Programme Officer, Diagnostics, Global Health Programme, Bill & Melinda Gates Foundation

This group, comprising seven industry representatives and 10 members from NGOs, held an open brainstorming session. Emergent themes were as follows.

At this stage, it is a tall order for the consultation to produce concrete recommendations. With regard to full open platforms, the discussions should be pursued; “we know so little - enough to be dangerous - right now... and we need to get more informed... and fill current knowledge gaps”. The question of business models is a complex one that changes depending on what is meant by “open” or by “interoperable”; but without solving the business model, the question is dead. This is an urgent priority.

In discussion of the business model the example was raised of Adobe and the PDF system. Adobe decided to bequeath the standard to ISO and make it fully open, with the result that now the PDF is the standard for that type of document management; Adobe has a massive presence; and PDF has become a brand name. Counterintuitively, this move appears to have to increase Adobe’s stake in the market. Diagnostics manufacturers should look at their existing systems similarly: would opening them up have a comparable effect? Finding effective business cases may depend on building on what already exists, morphing existing things.

Attention must also be paid to the health care systems into which we want to place the interventions: a perfect diagnostics system can be neutralised by an imperfect health care system. With this in mind a mechanism is required for capacity building, with diagnostic interventions an element of a broader package.

## **Discussion**

It is not easy for donors to impose standards. The business model remains key: working today, we already see technology from companies making money in the developed world that is used to fund work in and for LMIC markets. But it is difficult to get the right business model in place, and having donors impose standards on this environment would be difficult. There is a need to pick the right time: and the best way to do this is to let the market choose. At one point, one technology can naturally become the standard: with regard to the PDF example, Adobe did become the ‘winner,’ but only after a number of years in the market.

Discussion centred on whether the business model for global health diagnostics should also consider innovations in finance. For example, might it be adequate to drive to minimally acceptable margins for the POC diagnostic products, and to underwrite the costs for research, development, manufacturing and service support? This a financing problem, not just a technical problem, and innovative financing is important. If the idea of common platforms is trying to get to more affordable pricing at POC, the limiting case must be considered: if the diagnostics become as inexpensive as possible for LMIC markets, but premium pricing is established for the same products in developed world markets, such an economic model might have several advantages over the current situation.

The idea was introduced, currently in vogue among academic economists, of “co-optition”; competition and cooperation combined. Under this approach, competitors group together in blocs to specify standards. A number of larger buying cartels around the world use this model. The example was offered of Exostar in the military space collaborating to obtain volume discounting to purchase connectors, interfaces, wiring, informatics, security tools, etc. in order to be able to compete with other market entities elsewhere in the world. This approach has been the result of natural evolution in MBA programmes: leveraging one’s own capabilities and those of one’s competitors to grow the market and achieve better returns.

The point was made again that people in the field should be asked what their real expectations are: after all, one private sector participant pointed out, commercial companies meet customers before developing a product, to do market research. Others argued that the diagnostics space is more open to the needs of the field today than it used to be: we see partnerships between private companies, NGOs, users and others.

## ***Group 2: What would be the most suitable interoperability interface standard?***

***Moderator: Donald M Powers*** (Chairman, ISO/TC 212)

This group was asked to define the type of interoperability standard(s) that would be needed. The initial question was whether the instrument platform should be standardized so that different reagent manufacturers could develop a variety of testing consumables for the device; or whether the testing consumables should be standardized such that they can be used on a variety of instrument platforms made by different hardware manufacturers. It quickly became apparent that this choice was too simplistic. Unlike interoperability standards that only address information exchange and communication protocols, a POCT interoperability standard has to specify complex hardware and software aspects of both components of the system.

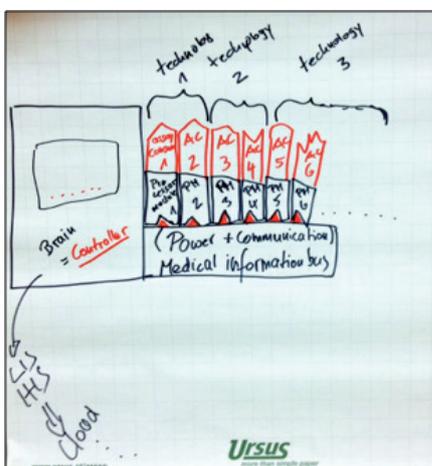
The first step was to define the architecture of the analytical system, which will depend on the analytical technologies involved. These range from well-established colorimetric endpoint measurements to relatively mature immunoassays to evolving detection and measurement technologies (e.g. molecular diagnostics).

The analytical processes all involve multiple processing steps, some common and some unique to a given technology; for example, most assays typically include sample preparation, mixing, temperature-controlled incubation, signal measurement, result calculation and data transmission. The group considered various alternatives, such as which steps should be performed by the instrument and which should be incorporated

into the reagent consumable, keeping in mind the cost implications of the different choices. While a sophisticated reagent cartridge could be designed that would carry out most of the steps and require only a very basic instrument to perform the assay, the cost per disposable unit would be several dollars. On the other hand, an instrument that would perform all technologies using low cost, single use cartridges would also be cost prohibitive.

The solution suggested by the group was a system comprising (1) a basic instrument to supply power to a generic medical information bus (MIB); (2) low-cost disposable reagent cartridges, containing only the unique elements of each assay (e.g., antibody); and (3) technology-specific adaptors that would connect the reagent cartridges to the instrument. These reusable technology modules would perform most of the steps required for the assay (such as incubation, mixing, signal generation, etc.), keeping instrument and consumable costs low. As new analytical technologies are developed or improved, the POCT system could be upgraded to perform new assays simply by adding an affordable adaptor designed and provided by the reagent manufacturer. This scheme would also accommodate evolving technologies such as molecular diagnostics, since the relatively inexpensive modular adaptors could be replaced as new generations appeared.

## Discussion



It was pointed out that the IEEE 11703 communications protocol based on USB would fit the proposed architecture. Given one standard for the MIB, because it creates an object model of the device in the controller it can provide information to outgoing messages: it can send the message and manage the object model without intricate knowledge of the information in the model. Many systems exist that demonstrate the feasibility of this concept.

The remaining challenge for the IVD experts will be to define the technologies needed to perform the POCT assays and to develop hardware standards for cost-effective reusable modules that will perform the assay steps with the accuracy, precision and reliability required for medical use.

### **Group 3: What kind of interoperability standards, from devices to health records?**

**Moderator: Christopher Isaacs, Senior Technology Officer eHealth, FIND**

A number of connectivity standards have been developed: this group considered how appropriate these standards are; whether new ones need to be developed; and how to achieve consensus on these standards and their uptake. In this context, it also considered the question need for a clearer definition of an LMIC, and whether standards need to be different for such contexts, or they could be the same everywhere.

Integration is often a satisfactory solution in the absence of standards; therefore there also needs to be clearer definition of open standards as opposed to interoperability. The latter can be achieved quite easily by using middleware, for example; do we necessarily need standards all the time and in all settings?

Countries have long-term visions and goals for standards and interoperability, but are more willing to start, and accept smaller steps, than to try to address immediate adoption of standards across the board; and while many standards exist and are suitable, some are not. Every implementation scenario is unique and standards should be considered in each case rather than as a blanket approach all the time.

Existing standards for the middle part of diagnostic chain—the data transmission—are probably the most successful elements: standards for GSM, SMS, email etc. do not need to be addressed. While most existing standards are good, and new ones are generally not required, we do need absolute clarification of how existing standards should be used and in what combinations, and how those apply to particular settings.

Uptake must be needs-driven, however; and it should be considered whether it is right for standards, technology and processes to be pushed onto LMIC users if they are not asking for them. A wider range of actors should therefore be involved in discussion forums like this one.

In the absence of real adoption of standards, smaller steps could be taken in the short term: for example, if it could be agreed to take a look at existing standards for patient ID at community level and get Ministries to adopt them, that could bring wider progress. Further effort could already be made to adapt what already exists to LMIC contexts.

This group's conclusions was that the main action point after this meeting should initially be to look at smaller steps that all can agree on, rather than trying to implement everything all at once across all settings.

## Discussion

It was asked whether the organizers of the consultation planned to provide a list of available standards for transmission of information from devices to electronic health records; in the ensuing discussion it was agreed that a simple matrix of today's available standards and common use case scenarios, based on an independent review of all standards and compilation of their usability information, would be helpful for the discussion.

Dr Moussy, the meeting organizer, clarified that one next step after this meeting would be to hold a series of working groups over several months, and the task of one of these could be to clarify existing standards.

### *Group 4: Regulatory issues: recommendations to speed up the process*

**Moderator: Uwe Scherf**, Deputy Director Division of Microbiology Devices, Office of In-Vitro Diagnostics and Radiological Health, Center for Devices and Radiological Health (CDRH), US Food and Drug Administration

This group considered the question of what would happen if interoperability standards were developed/adopted and new business models used in terms of their impact on the regulatory approval process.

There were a number of suggestions for ways to speed up the regulatory process: a common submission template taking into account the needs of field based entrepreneurs as well as experts; greater sharing of experiences; regional harmonization and reference labs; feedback earlier in the standards process for individuals new to it; a global guidelines document summing up what's needed in all different areas; agreement on risk classifications; and attention to semantic interoperability. On this last point Dr Scherf announced that in September a US Centers for Disease Control (CDC)/US Federal Drug Administration (FDA)/US National Library of Medicine (NLM) workshop would take place in FDA Headquarters: if participants are interested, they should email Dr Scherf; he will forward details as soon as they are available.

Further suggestions included a single audit programme; data sharing; enforcement of standards, perhaps by WHO; presumed conformity; mutual acceptance of date review; trusted regulatory approval by stringent regulatory agencies; and full consideration of the matter of liability. Over the total product life cycle, a named product developer needs to be liable; if something goes wrong means must be in place for reporting problems and following up. It was pointed out, however, that if the goal is to have modular connective cartridges, it might not be achievable while maintaining single vendor responsibility for the total product life cycle.

On interoperability, key points included the need to design systems with interoperability as an objective throughout the design process; making functions, performance and interface characteristics publicly available; performing appropriate performance testing and risk management; and building on the successful examples available. Examples offered for consideration included that of parallel development work for glucose sensors and insulin infusion pumps, where close communication took place throughout the various development processes. Another example given was that of wireless data transmission.

The majority of this group's conclusions were focussed on clinical assays and testing, but two other areas are also important—data transmission and informatics; and the interoperability of products with other products and with EMR systems. The group discussed using available ITU standards to frame and organize data and communicate it reliably—an area on which, though it may seem minor, hundreds of people are currently working.

## SESSION 5: **NEW BUSINESS MODELS AND NEW FINANCIAL INCENTIVES**

The second day began with a statement from Dr Francis Moussy: while day 1 was focused mainly on interoperability standards, day two would be about developing the business model needed to develop and introduce new POC diagnostic platforms based on these standards. He handed the floor to the Moderator, Mr Jean-Francois de Lavison, for an introductory presentation.

### *Update on business models & financial incentives*

**Mr Jean-François de Lavison, Ahimsa Partners SAS**

Mr de Lavison expressed the hope that the meeting would consider innovative models from other industries and start to develop consensus. The intent of the session, he said, was to define new, innovative business models providing cost-effective diagnostics for the developing world while simultaneously enabling increased opportunities for participants to achieve an acceptable return on investment. He underlined the importance of discussions such as this one, with brainstorming prioritized over concrete proposals, and with representation from industry. From his own experience running an endowment fund dedicated to health access for the poorest populations, Mr de Lavison argued that today we know what users need: work with the UN and NGOs has provided a clearer idea of what communities round the world are expecting.

Innovative business models could provide ways to access those markets: while industries often focus on emerging countries, a small proportion of the markets available, 90% of world markets still remains for which business models are needed. In this context there is also a need to re-examine funding in a way that gives momentum to industry to invest in such markets.

To make this happen it will be necessary to identify success stories from other industries, and create an approach encompassing new angles on access to funding; social entrepreneurship; and innovative business models. In doing so, it would be vital to consider IP issues and distribution—and to persuade big diagnostics multinationals to share their distribution networks to make complementary products accessible. Other issues of central importance would be complementary assistance; training; connectivity; local production; and technology transfer.

Mr de Lavison ended on an optimistic note: “We cannot resist change. We need to contribute to it, because change is inevitable”.

## *Driving Innovation from the BoP [bottom of the pyramid]*

**Ms Priya Dasgupta**, Director of Strategic Initiatives, Enterprise for a Sustainable World

Ms Dasgupta explained the etymology of the term ‘bottom of the pyramid,’ arguing that a great deal of learning can be brought from “the broader BoP space.” The Enterprise for a Sustainable World has considered how to build new enterprises on the ground within the BoP domain, developing a network of labs and hubs across the world in the process. Using India as an example of an emergent ecosystem, she noted that the ventures that have struggled most are those of large corporates. This raises the question of what is changing. Business is currently set up to serve the top of the pyramid, where most money is; but this market is getting saturated. In response, business has begun to move towards emerging markets and the middle classes in LMICs, adapting existing products and services to local conditions. But markets at the base of the pyramid — where 4.5bn people live on less than USD8/day— remain underserved; and for them, new products, services and business models are required.

In terms of actual business models, the BoP requires different elements to conventional business models, which Ms Dasgupta defined as: deeper dialogue, converting needs into markets; living the local life; clean sheet ideas; extended company reach through wholesale promotions, distributor drives and rural distribution; capital efficiency through employment intensity, contract manufacturing and local partnerships; co-invention of products using disruptive technology, local knowledge and non-traditional partners; generation of consumer surplus by removing constraints, increasing earning power and creating new potential; and the establishment of low cost distributed systems featuring local sourcing, decentralized production and minimized transportation costs.

Though BoP ventures should consider all elements of the business ecosystem, many only focus on one or two. Value proposition is key, from the perspectives of both the company and the end user. Ms Dasgupta gave the example of community research carried out by Enterprise for a Sustainable World that found young mothers were feeding eight month old children coffee in lieu of nutritional products; the conclusion was that significant time and resources would have to be applied to educating and changing mindsets in order to make the market viable. The lesson is to “look at the wider proposition.” Ms Dasgupta then listed a series of examples of attempted innovations to serve these markets in India, Kenya, Ghana and Mozambique respectively, outlining the strengths, weaknesses, success and lessons of each.

The BoP market space has, she argued, now evolved into BoP version 3.0, having moved from a movement characterized by the notion of “finding a fortune,” through the idea of “co-creating a fortune” to settle, for now, on a focus on “Purpose-driven ventures embedded in an ecosystem.” Asking whether today’s companies are really equipped to be in this space, she said that “this is a question that the industry needs to ask and answer.” In the diagnostics space in particular, the challenge remains the business model.

## Discussion

The prospect of network externalities was raised, whereby instead of simple focus on a product, a platform is created with a broader call than just a product to sell; how can this be adapted to a diagnostic framework? Diagnostics is currently a closed space that needs to be opened up to involve local entrepreneurs. The example was provided of Novo Nordisk, currently doing this by involving community health workers and pharmacists on the ground. As diagnostics technology is simplified, the range of people who can work with them expands—although, it was noted, training needs expand accordingly.

It was argued that the challenge now is taking these ideas to scale, and ensuring sustainability. The African Network for Drugs and Diagnostics Innovation (ANDI) is trying to establish social enterprises around certain products; could ranking mechanisms be created to support this? The response was that a big mismatch exists in social entrepreneurship between available funding and entrepreneurs on the ground; entrepreneurs do not appreciate funders' needs, and funders do not understand the market. Horizons have to be broadened in order to take the opportunities that exist in this space. The value proposition might lie in companies looking beyond their core industries at banks, mobile companies, educational institutions, etc.; but looking at a broader ecosystem entails experimentation and examination of innovators from emerging economies. Many interesting ideas exist in this respect, with diagnostics just one component of a broader push.

There are differences between enterprises and health as markets, one of which being that many products going into the market are regulated devices no matter where they are sold or used; so companies trying to introduce medical devices into market have a longer time to return on investment because of regulatory issues. In addition, it is not unusual to find that LMIC users expect devices made today still to be in use in 10 years because users cannot afford to replace equipment every time a new version of Windows is released. LMIC countries spend little on health, most of which goes on salaries, and very little is left for equipment and IT. In this context, a plea was made to funders: companies such as Microsoft and Google must provide longer-term support for their operating systems in order to sustain development. In the UK, it was claimed, some companies' production lines are still running MS-DOS, because there has been no need to change it.

The BoP approach is not as easy as it sounds when faced with reality, where the only products that really succeed are those that allow everybody in the chain to make money. The usual reality, then, is that cheaper devices only allow people in the middle to make more money while patients continue to pay the same price. In this context the value proposition must be in place for systems and countries to stop health care issues; and implementing more expensive but more effective devices is often significantly cheaper in the long term, because they're more effective at actually dealing with the basic health care problem.

At this point Dr Jim Gallarda of the Gates Foundation issued a challenge to companies:

“ Step out of your current thinking, look at that ecosystem, and come up with proposals... adopt a position of ‘OK, if we do it, here are some ideas as to how.’ Look at the reality and change it. ”

The discussion ended with consideration of whether, fundamentally, a BoP approach can really work in the diagnostics space; Ms Dasgupta argued that it can if practitioners “think outside the box”: it is about value proposition and how to scale and grow.

### ***How might new business models move diagnostics from interoperability to innovation?***

***Dr Anthony So, Program on Global Health and Technology Access, Sanford School of Public Policy, Duke University***

Dr So offered a series of principles for discussion for the meeting to consider, to see whether they could work for diagnostics. He ran through key ways in which interoperability standards might affect the value chain. Looking at push/pull mechanisms, he observed that the impacts of incentives can be very different depending on the nature of the incentivised firm: large pharmaceutical firms, for example, have provided historical examples of companies doing work (mostly related to drugs for neglected diseases) on a no profit/no loss basis, for reputational gain, CSR and long term market access. Small companies, on the other hand, face different opportunity costs and may engage the LMIC market for profit. By pooling R&D inputs for diagnostics, sharing resources and risks is also possible.

Paper-based diagnostics represent a potential disruptive innovation: they could meet the WHO ASSURED criteria, but the low marginal cost of production may make such technologies less attractive for commercial development. Delinking return on investment from product price, a combination of push and pull approaches might enable diagnostics companies to put the necessary effort into developing them.

Disruptive innovation is likely to shape the base-of-the-pyramid market; and there is no reason why firms that do sustaining innovation cannot also do disruptive innovation. Products can also have dual uses that make them commercially viable: examples include eflornithine’s use for sleeping sickness and for removing facial hair in women; Mectizan’s use to treat river blindness and also heartworm in dogs; and Posaconazole and Ambisome’s use both for antifungal and kinetoplastid diseases. Using dual market licensing, companies can also first develop a product for low- and middle-income countries at close-to-marginal cost, using public funding; and subsequently license the

then-proven technology platform for commercial use in industrialized markets. This, however, relies on commitment of public funding and greater public purchase over the value chain of R&D. Sharing resources, risk and rewards should suggest principles by which to benchmark solutions, ensuring financial returns but also accessibility for those in need.

## Discussion

Regulatory uncertainty or shifts in regulatory standards can upend diagnostic R&D efforts. Clinics anchored to existing diagnostic platforms and preferring to await the next version of such technology can slow adoption of new tests. Slow adoption, and countries making slow buying decisions, are difficult for companies. The example was given of the CD4 initiative persuading many SMEs into the market to make POC CD4 tests, then WHO changing guidelines on the use of CD4 to monitor treatment: this caused at least one company to go bankrupt, and several others to ditch eight years worth of research.

In many ways this emphasises the importance of adopting the 3Rs (sharing resources, risks and rewards) for diagnostics. Several prizes for diagnostics—the UK Longitude Prize, the EU Horizon Prize and the U.S. government’s diagnostics prize—targeting antibiotic drug-resistant organisms offer for scope for different designs of such rewards. A “winner takes all” prize may fail to reward second comers, with better diagnostic test performance, whereas the UK Longitude Prize set aside prizes for those contributing to the success of others by cross-licensing or making available their findings for others to build upon. Less clear is how these prizes will ensure low prices and affordability of diagnostics for those in need.

Prizes are, however, part of the larger ecosystem; they do some things well but not all. A paper was published recently for the World Intellectual Property Organization (WIPO) showing that the existence of a fairly small prize greatly boosted the number of applicants for US National Institute of Health (NIH) grants to do related research; these dynamics are part of a more complicated design involving a hybrid role of push and pull mechanisms. Prizes assume competitors can run the race under their own power, but not all can play; some companies need some push support to be able to compete. It was suggested that mechanisms could be devised to support promising contenders for prizes. Using Innocentive—an online platform—prizes can also be used strategically and cost-effectively to add to the ecosystem in other ways; for example, to develop and qualify cancer cell lines for chordoma research.

The vicissitudes of available grant funding can make R&D stop-start and cause expertise to be lost when the grant ends; there is currently a disproportionate balance of funding between the early part of research, beloved of donors and generating much publicity, and the fact that there is very little money available to translate research into practice.

Many interesting ideas die in this middle stage as a result. A grant can last three years, but more typically eight are required to get a product to market. Projects are underway to reshape public financing, and a range of approaches to funding are possible: we must allow failures along the way and “hope the horse emerges at the end of a five year period”. A lot more effort is required on this front.

The argument was made that technology cannot be discovered in isolation from user communities; and one important outcome from this meeting would be a decision how best to engage those communities.

Polyvalence is important: if the same device can be used for different assays, the costs of maintaining multiple platforms can be avoided.

Small developers may lack the funding and resources required to weather changes in diagnostic guidelines, whereas big companies controlling the diagnostic platform can lock up smaller diagnostic test markets.

### *Lessons learnt from the GAVI model*

**Mrs Jonna Jeurlink**, Senior manager APP, The Vaccines Alliance (GAVI)

Mrs Jeurlink outlined GAVI, its history and current strategy; and its relationships with all the other players—civil society, governments, funders, the UN, and industry. Partnerships with the private sector and a focus on market sharing have been key to its successes, and the organization’s approach has always been based on synergy, with country partnerships at its heart and innovative approaches to resource mobilisation, market shaping and vaccine delivery.

Private sector involvement is not just about financial resources, but also about sharing skills, expertise—for example, working with DHL and Heineken to strengthen cold chain ability—and voice; the private sector has strong links to policy makers and plays an important advocacy role. They have also focussed on a market shaping approach, through creation of a reliable LMIC market for vaccines using forecasted and pooled demand, and the use of advance market commitment (AMC) to accelerate affordable supply of appropriate vaccines for developing countries. This balances supply and demand, ensuring security of supply, minimising the cost of vaccines, and fostering development of appropriate and quality vaccines. More remains to be done, however: full understanding of future innovations that can be made, and areas in which innovation is particularly needed, will make a real difference to the mission of making these vaccines more available.

It is always important to find the win-win situations; for GAVI these were (a) pooling of funding and demand and being a strong negotiator with suppliers to transform their

product lines; and (2) the partnerships themselves—working with WHO and the private sector not just for cash, but to build strength.

## Discussion

GAVI has brought companies into its partnership and increased reliability of forecasting: this is an important message to send early to suppliers. They have also involved countries, persuading them to contribute money. This was accomplished through strong advocacy and the deliberate building of political will, helped by a strong case around the cost of immunisation programmes, which for a cheap investment provide huge impact in education and community building. This economic case allowed advocacy to ministers of finance as well as health. National champions, presidents, ministers and civil society have all played important roles: political will is vital for success.

Diagnostics players can learn a great deal from the GAVI example. Even if the industry takes on board the BoP lessons and engages in local advocacy, a sponsor is still required at the heart: with diagnostics, somebody must be responsible for the quality of the device and they are responsible if things go bad. So why not, instead of a heterogeneous strategy, try to build a more efficient mechanism, a 'GADI'?

One big issue is that diagnostics are less sexy than vaccines: it is harder to sell their value; the industry needs to do better job in this respect. Champions are required; advocacy is required; compelling arguments are needed for how diagnostics save lives. While the world at large may not appreciate the value of diagnostics, 70 per cent of critical medical decisions are based on testing. Chances have been missed in the past to rectify this image problem, but a new opportunity has arisen that should not be missed: antimicrobial resistance (AMR). There will be no impact in this area without diagnostics. WHO will have huge role to play in raising the profile of AMR diagnostics.

## *Social Innovation in Health: developing new models to enhance the access to diagnosis and treatment*

**Dr Beatrice Halpaap**, *Special Programme for Research and Training in Tropical Diseases (TDR), WHO*

TDR is a Programme hosted at WHO and cosponsored by the United Nations Development Programme (UNDP), the United Nations Children's Fund (UNICEF) and the World Bank as well as WHO. Its mission is to foster an effective global research effort on infectious diseases of poverty and promote the translation of innovation to health impact in disease endemic countries. Its brief is to look beyond technical innovation to social innovation—overlapping greatly with the declared purpose of this consultation.

Dr Halpaap outlined TDR's Social Innovation in Health Initiative (SIHI), which involves a range of heavyweight partners in promoting and enhancing, through research, the application of social innovation in health care delivery in infectious diseases of poverty. SIHI, she said, promotes and fosters research on new models to enhance access to prevention, diagnosis and treatment, and its operational approach is to generate evidence, strengthen capacity and build networks. Running through a list of good examples of social innovations selected for SIHI, Dr Halpaap expressed the hope that this type of partnership is also possible for diagnostics.

## **Discussion**

In response to a question from the floor Dr Halpaap outlined a TDR event taking place in Annecy, France on 2-4 December 2015, which would be attended by experts from different disciplines and sectors—private, international organizations, academia, implementers, health systems and innovators. Participants will share their experiences, identifying key challenges in research to advance and stimulate the application of social innovation to enhance health care delivery.

Some commonalities exist between the social innovation and BoP approaches; when SIHI began, it focussed on social entrepreneurship specifically. Later, when partnership was extended to others, attempts were made to integrate its work into health systems to make it sustainable and engage with hybrid models.

## ***Implications from business models for diagnostics test systems designed for resource limited settings***

***Dr Mickey Urdea, Halteres***

Based on experience of working with the Gates Foundation and also with a number of large diagnostics companies, Dr Urdea outlined the results of modelling exercise looking at business ecosystems. This was generated by a dynamic market model and large-scale research involving 200+ interviews on 70+ sites looking at specific company opportunities and networks. The findings present a number of big opportunities that might be of interest to diagnostics companies.

The private sector plays a big part in the LMIC context—for example in Uganda, where 20 per cent of people seek private health care, but because of the difference in what they pay, constitute about 60 per cent of the market. Looking at price differences, both are required to attract business. The research was expanded to cover community health workers in LMICs and pharmacy clinics and in-store clinics in the US and EU, including diagnostics for HIV, TB, maternal health, HPV, HCV and other disease states. In modelling the outcomes, Halteres deliberately assumed a high level of cost, assuming that new

businesses would be built from the ground up; whereas in reality this may overestimate the cost as the tests tend to be added on to existing systems.

The ecosystems modelled cover five scenarios: in Scenario 1A, integrators do everything themselves, making instruments, panels and cartridges; in 1B the manufacture is split amongst three integrators; 2 is the same as 1 but there is a contract manufacturing organization (CMO) partner for cartridges and instruments; scenario 3 is a semi-open approach with a CMO, as in scenario 2, plus three partners for panel production; in 4 the split amongst three integrators is regional; and in scenario 5 the company does everything, but buys in all the technology. The model allows all of these approaches to be tried, and observation of what happens when relationships and other factors are changed. Outputs are varied and allow tracking of costs and projected revenue possibilities, insight into opportunities for different companies and models, etc. “Groups of people who want to develop these networks can sit down and play with these models together until they come up with something they think is going to work”.

The summary output to date suggests that ecosystem profit is capped by underlying economics. Operationally it can support multiple partners; transfer prices move available profit from one participant to another, and integrators’ margins are at risk in scenarios where they play the middleman. The ecosystem’s profit can be reduced by inefficiencies and redundant operations: the most efficient approach is a vertically integrated one, followed by a variant with CMO; regional fully integrated competitors introduce added ecosystem costs (with the requirement to produce full set of panels); and the cost and time trade-offs between Technology and Panel partners are important.

This model is publicly available for access and review.

## Discussion

The cost of servicing is of great importance. The reality of service and support in LMICs is that a fantastic business model may exist, but providers need to prepare to “hand-hold every step of the way”, with the finances behind them to support every clinic and every unskilled, multitasking scientist. In this context a great deal of money is spent operating on the ground, ensuring quality management, setting up accreditation facilities, etc.

It was suggested that modelling could also usefully be done from the perspective of health providers, who would be running a cost benefit model; and with each iteration, that prevalence of testing could be factored in. Point-of-care diagnostics in a clinic with 1,000 patients doing only two tests a month are not, for example, cost effective for a health authority when compared to a hospital doing thousands of tests; the cost per test becomes important. Many actors are looking at the marketplace in many different ways, however, and the entirety of the ecosystem must be taken into account: no matter the stakeholder, the value of the technology must be understood. Stakeholder’s various

roles must also be examined: who benefits from what; who is responsible for value; and what roles different stakeholders have. This has not yet been fully analysed. Thorough investigation of how this landscape can be moved to profitability is a great pathway by which to incentivise companies and help them map out strategies.

The model assumes a five-year development period followed by 10 years of launch, with a three-year time lag from launch to implementation. A number of factors go into such a scenario: many businesses would look at an eight-year loss and be unable to sustain it. Halteres attempted to make this model as difficult on the cost/time side as possible, judged on markets, and still ask, is the opportunity valuable? With that in mind, it should be remembered that in reality most companies would be much further along on the technological side than was assumed by the model, which started everyone from scratch.

### ***UNITAID Patent Pool Initiative***

***Dr Philippe Duneton, UNITAID***

UNITAID is about pushing innovation and 'connecting the upstream [research] with the downstream [reality in countries]'. The organization has highlighted the importance of diagnostics since 2009, and in particular the need for viral load diagnostics to monitor and increase the quality of care of HIV-AIDS treatments.

UNITAID's goal is to provide access to medicine and to life for people in LMICs, while ensuring that this work is linked with global goals. There are many aspects to this picture, encompassing medication, devices and systems; and the outcome is that any dollar invested in UNITAID results in five dollars of savings across all projects. This is UNITAID's contribution to the global fight against HIV, TB and malaria.

New areas for intervention, adopted by UNITAID executive board in June 2015 are: improvement of adult antiretroviral therapy in LMICs; enabling scale-up of PrEP & linkages to testing; and improving HCV diagnosis, especially for HIV/HCV co-infection. Two main things are being fought for: doubling the number of people on treatment with more tolerable drugs and without resistance; and getting patients onto one fixed dose per day with first- or second-line therapy. These goals are strongly linked with testing, and the need for simple tools for diagnosis. A third of UNITAID investment is dedicated to diagnostics for HIV, TB and malaria.

The medicines patent pool is a mechanism specific to UNITAID, with a rationale so simple that in the beginning people didn't believe that it would work. Patents on full

HIV treatment can be held by different patent holders, making it difficult to develop a pill that brings together various active ingredients; and a patent on one of the components of a fixed dose combination (FDC) can prevent its development completely. But licensing can address this challenge by pooling all the patents needed to develop more affordable combination pills, thereby circumventing these problems. The goals set in the pool are driven by public health, not industry; and the outcome is that now all manufacturers of HIV generics are involved in the pool.

The market dynamics of HIV medications are, however, quite specific, and not the same as for TB and other drugs; but the UNITAID board is examining whether this work can be applied to other drugs, and talking to the Gates Foundation about whether this can be made relevant in other areas. This particular model may not work for diagnostics but some kind of adaptation might; taking into consideration the specificity of the diagnostics world it seems like steps forward are possible.

UNITAID's experience with diagnostics has led to the conclusion that connectivity is a key priority. There is no optimal solution but a mix of available solutions is required in the field. The task is to understand the right mix and plan it with countries and partners. There is an urgent need for tests to be given to patients who are then monitored, providing huge value for money for people in need and for their health systems and governments.

## **Discussion**

There was discussion of whether a patent buyout approach could be applied to diagnostics: a fund could be created into which donors or governments could contribute, which could acquire patents for technology or knowhow related to diagnostics, prioritising things the funders think are medically relevant or interesting. We need to decide what issue we want to fix in terms of access, and then how to speed up the process in a way that's transparent and feasible. A fund may well be relevant to achieving this.

Interoperability of systems can be taken as read for the UNITAID approach; there is strong appetite from both UNITAID and WHO to move in the direction of full interoperability. It is difficult to make it simple, but the work needs to happen now, because it takes time. If not addressed now, however, we will end up with a situation analogous to today's smartphone market: a range of devices with flaws that cannot work full with one another: inaccessible batteries, different plugs, different power units, different cables.



## SESSION 6: CLOSING STATEMENTS

Dr Moussy began the last session by reiterating the consultation's main goal: to get input from all stakeholders, with that of industry being particularly crucial. Taking into account that consensus developed over the preceding two days that discussion should continue on business models and interoperability standards both with regard to connectivity and physical interfaces, he proposed the formation of three working groups:

1. A group on connectivity interoperability standards, tasked to make specific accommodations by the end of November 2015, taking into account the many standards and structures already existing and how to build on these.
2. A group on interoperability standards for physical interfaces, with the same task and schedule.
3. A group on business models, tasked with examining the many existing possibilities and making specific recommendations, with the same schedule.

Dr Moussy suggested that these groups should present concrete proposals at a meeting to be organized in December 2015.

In the short term, the WHO steering committee for the diagnostics project would work out the details of how to run these groups, and address the task of facilitating the creation of a consortium.

Dr Moussy ended by requesting that anyone keen to participate in the working groups or any related consortia should email him: [moussyf@who.int](mailto:moussyf@who.int)

### Closing feedback from the floor

The meeting ended with an open request for feedback from the floor. Many participants took the opportunity to thank the meeting organizers and confirm interest in participating in the working groups. The following themes also emerged:

- A number of connectivity working groups already exist in WHO, many of which are disease-led; it is important to reach out to these groups where appropriate and ensure that all work is integrated.
- Access to diagnostics remains crucial, and is a key barrier to accessing treatment in LMICs, though it is downplayed in much of the public discussion; the ongoing work of this consultation is therefore of great importance.
- Standards cannot be developed without partnerships: there is a strong necessity for more and better partnerships between the private sector and NGOs.
- Smaller businesses like more collaborative efforts, because they open up markets to more players than just large companies.

- With regard to physical interoperability it would be impossible to approach a standard by December 2015; but the target of a roadmap for technical guidelines would be feasible.
- Ana Orlova, representing a number of organizations including the ISO TC215 working group, offered to connect participants to their respective national representatives already on ISO TC 215 so that they could learn priorities of national member bodies, and see what ITC has already done in the area of health informatics technology standards. She also volunteered Johns Hopkins for collaboration on any training in connectivity standards and diagnostics.
- When all the standardisation is done, a great deal of data will be captured, and the information management and business requirements that will derive from the systems will be of key importance.
- The tasks of the two interoperability working groups would be bound to overlap; a good place to start would be the development of target product profiles (TPPs), making basic assumptions about goals to inform business modelling decisions. Many TPPs exist already; work should commence with these.
- Working groups have been a successful model in the past: for ISO TC 212, an industry consortium defined the necessary architecture, scope and requirements, and then worked with SDOs to develop guidelines. It might be advisable to prioritise the formation of an industry consortium.
- With regard to connectivity, much of the discussion involves network technologies; there is no compelling case for diagnostics products to interact with one another, so it should be clarified whether connectivity refers to that between devices, or that devices and an electronic health record. Networking principles should be incorporated into the activity of all the working groups.
- A greater taxonomy of what exists and what could come would be useful, supplemented with country case studies and examination of those facing the relevant challenges.
- The full spectrum of disease issues should be taken into consideration, including non-communicable disease, issues of AMR, etc.
- All stakeholders should be included in the next phases of discussion: those who pay for the diagnostics, government representatives, and especially the end users.
- The business model group should consider the entire ecosystem, including the cost of training, quality control, quality-assured results and so on; not just interfaces and connectivity. The infrastructure beneath the diagnostics devices must be sustainable.
- A request was made for the next meeting to share the output of business modelling for health authorities looking at cost benefit, allowing insight into target price points to meet cost/benefit analyses on testing systems.

- Some companies are not ready to participate in the physical connectivity working group: they do not have the necessary manpower to do it, and some participants believe that it is too early for this work.
- GAVI emerged from a World Bank meeting at which an ‘unexpected energy’ developed; a 12-page memo was sent to Bill and Melinda Gates asking for USD8m dollars, quite modest, to respond to this energy; discussions ensued and the outcome was a USD 750m investment. The diagnostics world is at the same stage now: AMR is the opportunity that allows DX to make its case and correct its past mistakes. A “nice heterogeneity” of stakeholders is present at this consultation and we are “smarter collectively than we are individually.” This is a moment of opportunity.

Dr Moussy concluded the meeting by agreeing that the moment should be seized to create something big to provide better access to diagnostics in LMICs and that the result of this meeting will help shape WHO diagnostics strategy.

## ANNEX A – MEETING AGENDA

# GLOBAL CONSULTATION ON DIAGNOSTICS INTEROPERABILITY STANDARDS

World Council of Churches, Geneva, Switzerland (10 minute walk from WHO HQ)

11-12 June 2015

### Thursday June, 11, 2015

8:30 – 9:00	<b>Registration</b>
9:00 – 9:15	Welcome remarks and goals for the consultation. Definition of Interoperability. Consultation logistics: <b>Francis Moussy</b> (Chair), WHO and <b>Jean-Francois de Lavison</b> (Moderator), Ahimsa Partners.
9:15 – 9:45	“How Interoperability Standards May Shape the Landscape for Emerging Diagnostic Technologies?” <b>Jennifer Nuzzo</b> , UPMC (20’ + 10’ Q/A)
9:45 – 10:30	<b>Can we learn from other industries to facilitate the development of interoperability standards for diagnostics?</b> (15’ each + 15’ debate) “ The interplay between patents & standards”: <b>Marco Aleman</b> , WIPO  “ ITU and standards development”: <b>Simão Campos</b> , ITU
10:30 – 11:00	<b>Break</b>
11:00 – 13:00	<b>Previous and current work on diagnostic interoperability standards</b>  “Interoperable Diagnostics & Ecosystem Complexities - Gates Foundation Experience”: <b>Jim Gallarda</b> , Bill & Melinda Gates Foundation (30’: 20’ + 10’ Q/A)  <b>What works/ what doesn’t work/ blocking points</b> (15 min each + 15’ debate):  “(Semi-)Open Platform Approach: Enabling Partnerships in IVD”: <b>Jeroen Nieuwenhuis</b> , Philips “The PanDx Approach to Cartridge Interface Standards.”: <b>Wallace White</b> , Stratos “The GSID System: Creating a Universal Reader at the Point of Care.”: <b>Ian Francis</b> , GSID

“Standards Developing Organizations – Perspectives on POCT Standards”: **Don Powers**, Chairman ISO/TC 212

“Connectivity and E-health standards”: **Chris Issacs**, FIND

13:00 – 14:00

**Lunch**

14:00 – 14.15

Recap: what are the lessons learned from previous work on standards?

14:15 – 16:15

**Working Groups (WG) session: What role interoperability standards may play in catalyzing the development of new POC diagnostic tests? Which interoperability standards are needed? What are the obstacles to their development and use? What are the possible solutions?**

**WG 1:** Feedback from industry and NGOs on interoperability standards. Why haven't we made much progress? What are the reasons? (Lack of funding, IP issues, liability, financial incentives...) . What are the requirements from developers and users? Open business models: open standards will facilitate collaborative approaches, which can speed innovation. Recommendations? (Moderator: Tala de Los Santos)

**WG 2:** What would be the most suitable interoperability-interface standards? (Moderator: Don Powers, Chairman ISO/TC 212)

- - A specific testing platform in a way that allows manufacturers to develop a variety of testing consumables for the device;
- - or the testing consumables in a way that allows manufacturers to design platforms that are built to enable use of standard consumables

**WG 3:** Which kind of interoperability standards from devices to electronic health records? A number of connectivity standards have been developed. Are they appropriate? Do we need to develop new ones? How to get consensus on these standards and their uptake? (Moderator: Chris Issacs, FIND)

**WG 4:** Regulatory issues, recommendations in order to speed-up the process? If interoperability standards are developed/adopted and new business models are used, what will be their impact on the regulatory approval process? What needs to be considered? (Moderator: Uwe Scherf, US FDA)

16:15 – 16:45

**Break**

16:45 – 17:45

**Restitution from the working groups (10' each)**

19:00

**Reception at WHO**

## Friday, June 12, 2015

8:30 – 8:45	<b>Debrief of the previous day</b>
8:45 – 11:15	<b>New business models and new financial incentives:</b> Introduction for the session: “Working on new diagnostics business models : dream or reality?”: <b>Jean-Francois de Lavison (Founder Ahimsa Partners)</b> (10’) “Driving innovation from the BoP”: <b>Priya Dasgupta</b> : ESW (20’ + 10’ Q/A) <b>Sharing experience</b> (15’ each+ 25’ debate): “How Might New Business Models Move Diagnostics from Interoperability to Innovation?”: <b>Anthony So</b> , Duke University “Lessons learnt from the GAVI model”: <b>Jonna Jeurlink</b> , GAVI “Social Innovation in Health: developing new models to enhance the access to diagnosis and treatment”: <b>Beatrice Halpaap</b> , TDR “Implications from business models for diagnostics test systems designed for resource limited settings.”: <b>Mickey Urdea</b> , Halteres “UNITAID Patent Pool Initiative”: <b>Philippe Duneton</b> , UNITAID
11:15 – 11:45	<b>Break</b>
11:45 – 12:30	<b>Feed-back : go/no go/ next steps</b>
12:30	<b>Lunch and end of the meeting</b>

## ANNEX B – LIST OF PARTICIPANTS

### LIST OF PARTICIPANTS

11-12 JUNE 2015

#### Governmental Organizations

**Isabelle Buckle**

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