The role of e/mHealth in tuberculosis and tobacco control

Geneva, 25-26 February 2015

World Health Organization

ERS EUROPEAN RESPIRATORY SOCIETY
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# Meeting Report

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# WHO/ERS consultation : The role of e/mHealth in tuberculosis and tobacco control
## 25-26 February 2015

**Centre International de Conférences Genève (CICG), Switzerland**

**Meeting report**

### Background to the consultation: why TB, tobacco and eHealth?

Tuberculosis (TB) and tobacco smoking represent two major, global public health concerns. About 9 million new cases of TB emerge each year and 1.5 million die from the disease (including persons with HIV). Tobacco is the largest preventable cause of death in the world: almost 6 million people are estimated to die from smoking every year. Smoking substantially increases the risk of TB and death from the disease; more than 20% of the global TB incidence is estimated to be linked to tobacco smoking. The associations between TB and tobacco lay down the scientific foundations for joint action. The application of information and communication technology (ICT) to health care - eHealth/mHealth or digital health (see Box 1) - could provide new solutions and avenues for synergy in public health action against both conditions. State-of-the-art ICT is progressively reaching the most remote corners of the world. Internet coverage and portable telephony have seen a huge increase in recent years, opening up new perspectives in the care of patients and the control of multiple diseases and risks to health. *Be He@lthy Be Mobile*, a joint initiative in digital health between the World Health Organization (WHO) and the International Telecommunications Union (ITU), is one example.

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**Box 1 : KEY DEFINITIONS**

**Information and communication technology** (or **technologies**) (ICT) refers to the means employed to provide access to information through internet, wireless networks, cell phones, and other communication media.

**eHealth** (electronic health) is the cost-effective and secure use of information and communication technologies (ICTs) for health and health-related fields.

**mHealth** is a component of eHealth, and involves the provision of health services and information via mobile technologies such as mobile phones, tablet computers and Personal Digital Assistants (PDAs).

**Digital health** is used in this report to refer collectively to "eHealth" and "mHealth".

**eLearning** is the use of electronic educational technology in learning and teaching.

**mCessation** is the use of mobile electronic devices to support tobacco smokers to quit.

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The potential for ICT to combat TB and tobacco remains underexploited. While many creative efforts and products have been implemented in different countries, and their initial results have been appealing and bear promise, evidence for their effectiveness is as yet incomplete and measures to ensure their large scale implementation very limited, making it difficult to appreciate their potential to improve programme performance.

WHO's Global TB Programme (WHO/GTB) and the Department for the Prevention of non-communicable diseases (WHO/PND) are working with the European Respiratory Society (ERS) to promote the global utilization of ICT in lung health. To this end, a consultation was planned early on in this joint WHO-ERS

collaboration to bring together technical experts in TB, tobacco control and digital health, as well as the corporate sector, main funding partners, and end-users who have a stake in this area. The four specific objectives of the meeting were the following :

- the state of the evidence relating to the effectiveness of mobile text messaging and other adherence aids within a package of other interventions for TB patients and tobacco cessation summarised and direction provided for other complementary research in this area;
- a listing of other eHealth interventions in TB & tobacco control, highlighting lessons learnt, assessments and recommendations, best practices, and cost-effectiveness evaluations updated with new solutions and "pipeline products";
- target product profiles (TPPs) for priority ICT solutions drafted by the participants; and
- work on case studies in scalability of interventions planned and initial contact with candidate countries established.

The consultation was held on the 25 and 26 February 2015 in Geneva and consisted of a number of presentations on the state of the evidence and best practices, group work in 4 "work streams" aligned to the WHO/GTB conceptual framework on eHealth in TB care, and plenary discussions. This brief report summarises the main points arising from the presentations and discussions. The agenda and list of participants are annexed; the active participation of all those who attended and the different roles that they played is gratefully acknowledged (Annexes 1 and 2). The presentations can be accessed through this link.

# Day 1

## Welcome Remarks

The participants were greeted by Dr Elisabeth BEL (President of the ERS), Dr Mario RAVIGLIONE (Director, WHO/GTB) and Dr Douglas BETTCHER (Director, WHO/PND). In her address, Dr BEL stated that this meeting united a critical mass of experts who will play different roles in shaping the future of digital health for TB and tobacco control. The outputs of the consultation will feed into the development of different ICT concepts across different dimensions, namely patient care, surveillance and monitoring, programme management and eLearning. The ERS is committed to support such initiatives in order to revolutionize the use of ICT to save patient lives. Dr RAVIGLIONE thanked the ERS for its vision in supporting innovative approaches to TB control, enabling the further expansion of work that GTB has started in the various aspects of ICT for TB, such as the promotion of electronic recording and reporting, conversion of training material on drug-resistant TB for health-care workers into an application for tablet computers and smartphones, and technical fora on digital health through a collaboration with partners. The theme of this meeting resonates very closely with the End TB Strategy, which was approved by the World Health Assembly in 2014, and which views the innovative potential of ICT as an important means in maximizing the effectiveness of existing TB control interventions in the coming years. ICT will have an application in the non-traditional approaches to TB control, such as action on smoking, diabetes and other non-communicable diseases (NCDs). The rapid pace with which ICT spreads and diversifies gives us legitimacy to plan interventions which would have only been the subject of dreams a mere decade ago. As a result of this consultation we hope to inform better the ICT developers on how to align their systems to the needs of prospective users. Dr RAVIGLIONE stressed the need for participants to learn from experience and evidence, share ideas, identify the most promising tools and concepts, and strive to develop them further. Dr BETTCHER also thanked the ERS and he emphasized that we are now at a crucial juncture as later this year the United Nations will adopt the Sustainable Development Goals (SDG) which will determine the development agenda for the post-2015 period. This consultation, with its focus on ICT, TB and tobacco control, could provide concrete models to follow on how to work horizontally across the different disease silos, an important motif of the post-2015 development agenda. There is a

clear link between active and passive tobacco smoking and TB outcomes such as infection and disease, relapse, and mortality. Tobacco smoking and TB are both widespread across the globe and current health systems do not have the resources needed to support everyone at risk or already suffering from either condition. Yet we live in a connected world and globally there are more phones than human beings. Policy-makers and practitioners recognize the huge opportunity this offers to bridge the gaps in access and individual management of diseases and risk factors, especially diseases which need ongoing monitoring and treatment. Persons with tobacco addiction or with TB both require a long-term commitment to achieve a positive outcome: this is where mobiles lend themselves particularly well to improve communication with the health professional, inform the patient, and enhance adherence. The *Be He@lthy Be Mobile* initiative - run jointly between WHO and ITU - capitalises upon these strengths to promote large scale adoption of mHealth by countries to prevent, diagnose and treat NCDs. By building upon this experience TB and tobacco in programmes can unite to move faster towards the disease reduction targets for both of these conditions simultaneously.

## Conceptual framework for the application of e/mHealth in TB and tobacco control and meeting objectives

Dennis FALZON - WHO/GTB, Switzerland; Dongbo FU - WHO/PND, Switzerland

This introductory presentation provided more background for the consultation, more detail on the scientific basis underpinning joint action for TB and tobacco control, and the reason why e/mHealth interventions are well suited to address both conditions in the same patients, same populations and for the same practitioners. For both TB and tobacco control, behaviour change and patient support are required for a lasting effect. The second pillar of the new End TB Strategy envisages broad action on the determinants of TB. Action on smoking would be an important entry point. The four functions of the conceptual framework of e/mHealth for TB care - namely patient care, surveillance and monitoring, programmatic management and eLearning - could be usefully applied to action on tobacco control as well as TB[1].

## Interventions for tobacco and TB control delivered by mobile phone

Caroline FREE - LSHTM, United Kingdom

The results of systematic reviews of published studies on mobile phone use in NCDs (including smoking) and TB treatment were presented. For tobacco control, the approaches and efforts for behaviour change varied and therefore the findings are not necessarily generalisable to settings where the preliminary social and legislative frameworks to promote cessation are not in place. In a number of studies, no statistically significant effect could be shown but in two studies interventions delivered by text messages increased biochemically-verified smoking cessation (Relative Risk ranging from 2.18 to 2.84). One of these - "txt2stop" - was implemented in 35,000 users throughout England and its design is now being adopted in New Zealand, United States and Costa Rica. For TB, there are less published studies but one trial showed an effect on sputum conversion in MDR-TB patients when phone calls supplemented care (not in non-MDR-TB patients). The evidence for studies of short text messaging (SMS) tailored to improve antiretroviral treatment (ART), contraception and heart disease prevention appears more compelling but the level of concurrent support needed from service providers may limit their widespread implementation due to costs. In conclusion, simple SMS reminders to patients do not appear to work but high-quality trials looking at optimal interventions for behaviour change and monitoring are needed. More qualitative work is needed to identify and better understand which barriers and factors influencing adherence can be addressed via mobile phones and whether different interventions, when combined with mobile phone interventions, show synergy.

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[1] WHO Global TB Programme. Factsheet. eHealth in the TB response. Scaling up the TB response through information and communication technologies. 2015. www.who.int/tb/publications/ehealth_TB.pdf

## Effectiveness of electronic reminders to improve medication adherence in tuberculosis patients: a cluster-randomised trial

James LEWIS - LSHTM, United Kingdom [via video link]

The presentation summarised the preliminary results of a large randomised controlled trial (RCT) held in China where mobile phone SMS were used to remind TB patients to take medications and follow appointments; these were backed up with support services (advice, direct observation and intensive management) in the case of failure to comply. In addition, medication monitors - which registered the opening of a pill-box - were studied in the trial, at times in combination with the SMS reminders. SMS reminders appeared to reduce default but were not observed to have a significant effect on preventing missed doses; conversely medication monitors showed an effect on adherence but not on default.

## Translating mHealth evidence to scale

Richard LESTER - University of British Columbia, Canada / WelTel, Kenya

The huge expansion in use of mobile phones in low resource settings carries with it the potential to improve health outcomes for a large number of patients and to enhance the impact of disease programmes. But even as mobile phones become the rage in many resource-constrained settings, their application in healthcare is still much lower than the other uses that they are put to. So even if an mHealth intervention is proven to work there is an added challenge to scale it up. The presenter used the example from WelTel Kenya1, a trial for HIV treatment adherence in 2007-2008, in which participants were randomised to receive automatic weekly SMS or no SMS on top of standard care. Patients were expected to respond to the nurse sending the SMS. Those who received the SMS had a significantly improved self-reported ART adherence and viral-load suppression compared to controls. Scaling up such an intervention could make huge savings for the target disease but could also benefit other conditions (e.g. TB, tobacco, asthma). It could also be applicable in countries and settings beyond those where it was studied. The size and type of the population (e.g. clients of private versus public care services) and the market size would be important considerations in scaling up. Projects must continue to innovate and find solutions to barriers and adapting on the basis of evidence if they are to succeed. Understanding which components of the intervention have been key to the success is important, particularly when many studies of simple SMS reminders have so often shown such a disappointing impact on adherence. For instance in another WelTel study on latent TB infection (LTBI) currently under way patients appreciated the nurse support at the end of the phone. Issues on practical advice, willingness-to-pay and challenges with government implementers were raised in the discussion.

## Be He@lthy Be Mobile : a joint WHO/ITU initiative

Sameer PUJARI - WHO/PND, Switzerland; Hani ESKANDAR - ITU, Switzerland; Roxana TINOCO - Ministry of Foreign Affairs and Culture, Costa Rica.

A joint mHealth initiative between WHO and ITU on NCDs was launched in 2013 - *Be He@lthy, Be Mobile*. The initiative takes a broad systems-approach, aiming to create a mobile phone platform which can cater for the mHealth needs of different disease programmes. The implementation model of *Be He@lthy, Be Mobile* requires governments to integrate and scale-up mHealth into the delivery of national health programmes, building upon the existing infrastructure and knowledge, and integrating elements of impact assessment from the outset. As we move towards the SDGs and beyond, the plan will be to continue to enrich the repertoire of best practices for large-scale mHealth interventions and promote widely the tools which are proven to work. A number of countries have endorsed *Be He@lthy, Be Mobile*, including Costa Rica, Norway, the Philippines, Senegal, Tunisia, and the United Kingdom. Initial projects have focused on mCessation interventions for tobacco control, a domain for which there is a comparatively solid evidence base for effectiveness. It is envisaged that the initiative will be introduced in future to other countries and to other disease programmes; for this purpose a number of toolkits on diabetes, wellbeing, cancer, nutrition, and alcohol are being developed. Partners collaborate in different

roles: at global level as coordinating partners, donors, providers of intellectual property, experts in guideline groups, monitoring and evaluation (M & E), and at country level as expert groups, innovators and implementers. Costa Rica, the first country to join *Be He@lthy, Be Mobile* in 2013, presented its mCessation programme. The Government committed US$1 million, partly funded through tobacco taxation, for the initiative. Over 1,000 people were enrolled in the first week of the launch and numbers doubled by the end of the month. Out of the smokers who stayed with the programme for 4 months, 43% reported that they had quit smoking. This was the country's first national mHealth programme, and it is now being considered as a model for mental health, diabetes, hypertension and other NCDs. The content developed has been placed at the disposal of the global initiative. The success of the initiative has been attributed to (i) strong Ministry of Health leadership, with a designated national "mHealth commission" coordinating the programme; (ii) a top-level and highly-visible, transparent cooperation between the Ministry of Health, ICT, eGovernance group, telecom operators, public and private health care providers and other stakeholders; and (iii) involvement of the national soccer team in publicity campaigns for the programme. It is expected that the project will be scaled up and 30,000 enrolments have been targeted by the end of 2015.

## Country experience in digital health for TB

### Video observed therapy for TB (United Kingdom)

Alistair STORY - Find & Treat, United Kingdom

The presenter described the background of virtual (video) observed therapy (VOT) for TB in London. About 10,000 homeless people are screened for TB each year in the city using mobile digital chest X-Ray. Many TB patients detected live in challenging social environments, complicating case-holding and making direct observation of treatment (DOT) difficult. A first successful attempt at VOT in a MDR-TB patient on an 18-month regimen was made in 2007 using Skype installed on a laptop connected to internet via a dongle. The intervention has evolved since and now the public TB services are providing VOT by giving out free smartphones and data subscription to patients, at a highly competitive cost when compared with the equivalent in community nursing time. Patients are trained during 1-2 visits. The smartphone is fitted with an application developed by the University of San Diego in the US; it does not store data. There are 86 patients on VOT at this point, including patients with M/XDR-TB some of whom are receiving intravenous medications. None have been lost to follow-up. The intervention is reported to work well in children too. It also helps counter stigma as it limits the number of home visits by a nurse, which raise questions in the neighbourhood. In 10 cases VOT failures switched back to DOT in early days when the app was still not well developed; literacy has proved challenging too. A RCT is now being carried out comparing VOT with classical DOT. The technique could have an application for LTBI and for other diseases such as hepatitis C.

### e/mHealth for tuberculosis (Republic of Moldova)

Viorel SOLTAN - Center for Health Policies and Studies, Republic of Moldova

Dr SOLTAN presented recent initiatives to improve TB patient outcomes in the Republic of Moldova, an eastern European country with a population of 4.1 million. Each year there are about 5,000 TB notifications in the country, of whom a third are estimated to be MDR-TB. TB treatment interruptions are frequent: among new sputum smear positive TB cases in 2011, 11% were lost to follow up or unevaluated. In 2013, the TB programme introduced an mHealth initiative to ensure continuity of treatment and increase adherence of patients during ambulatory treatment. By the end of 2014, 1,731 patients had been enrolled and 2,000 basic mobile phones distributed to the medical institutions. The intervention involves the sending of SMS reminders to patients plus additional information on treatment, adverse drug reactions, and health care services. The system also collects feedback from patients via SMS to confirm the dosing (originally the intervention was combined with an electronic medication

monitoring device but this was later discontinued).  The mobiles and SMS data plans were provided free of charge to the patients by two large, national, network providers as part of their corporate social responsibility activities.  In the intervention group treatment success was reported to be higher than the national average while interruptions declined, although a formal evaluation of effect has yet to be done. There is a plan to increase the span of the project as well as its scope, given the widespread network coverage and availability of mobile phones in the country (the number of mobile phone subscribers is equivalent to the whole population), cost of mobile services are low, willingness of patients to use mobiles to call the health care professionals, and there are opportunities to extend to other functions (e.g. electronic medical records, video tools) and to other associated conditions (e.g. tobacco use given that about 25% of adults are smokers).

## Implementation of electronic tools and cell phones for PMDT programme (Bangladesh)

Paul DARU - University Research Co. LLC, Bangladesh

Dr DARU presented the "TB mHealth program", a web-based monitoring tool supported by TB CARE II in Bangladesh to track community-based services for the programmatic management of drug-resistant TB (PMDT).  The basic function consists of a health-care provider registering a household DOT encounter on an Android smartphone and transmitting the data - including the geolocation of the visit - via mobile phone to a centralized server.  The package involved a free data plan.  The application consists of 7 screens and all data entry uses radio buttons and preset options (no free text needs to be typed in).  This provides the community PMDT manager information on daily adherence, adverse drug reactions and their management, and contact tracing within the same database.  Tabular and graphic dashboards can then be generated to summarise the indicators; these include mapping of geolocation using Google maps. The initiative reports increasing and near 100% compliance; 395 DOT providers are currently being monitored; remote monitoring reduced the human resource requirements for supervision.   The main lessons learnt were that smartphone interventions were feasible for DOT although users were less familiar with them and needed some training (1 day); network coverage was poor; however initial results are promising (90% success among the initial group of 37 MDR-TB patients).

## eLearning to improve TB management (Georgia)

Tamar GABUNIA - University Research Co. LLC, Georgia

Dr GABUNIA presented the eLearning modules developed in Georgia for both patients and physicians. The main motivation for the creation of these modules has been the need to reach out to more health care professionals as TB services decentralize in the country.  In Georgia there is no legal framework for continued education after the primary medical qualification.  eLearning presented a particular opportunity in the country given the rapid technological advances in recent years (including internet coverage), the option for learners to tailor self-teaching to their own pace, and its lower demands on travel and absence of health professionals when compared with traditional training.  In 2013 the government adopted an eHealth strategy and health facilities are now incentivised to invest in ICT.  The online eLearning courses for physicians are composed of 9 modules on TB care, accessible on the web free-of-charge, with multimedia elements (video and voice), and including multiple-choice questions for self-assessment.  The online course for patients is shorter (19 minutes), delivered in a similar environment, and also exists in an Android application for use on mobile devices.  It also has an option for time- and geo-tagging and can be used as part of patient counselling during the interaction with a caregiver.  Between September 2013 and January 2015 there were 3,999 users recorded as having accessed the modules and 71% were returning visitors.  Usage could probably improve if the physicians have better computer skills (only 18% of rural physicians polled in 2014 reported using the module), if internet coverage broadens, and if resources are provided to keep updating the content.  The eLearning initiatives were originally supported by USAID but resources for continued support in future have yet to be secured.

### Working in Groups : setting priority target product profiles for digital health in TB/tobacco control & promoting country scale-up

Hazim TIMIMI - WHO/GTB, Switzerland; Claudia DENKINGER - FIND, Switzerland

In the afternoon of Day 1, the participants split into four smaller workstreams aligned to the functions of digital health around which the consultation was organised: Patient care, "eDOT" & mCessation; Surveillance and Monitoring; Laboratory information systems; and eLearning.  Introductory presentations oriented the participants on how to structure the discussions within the workstreams in order to cover three dimensions, namely (i) identifying the priority products for future investment in each of the 4 workstreams; (ii) drafting target product profiles (TPP) for each priority product; and (iii) establishing successful partnerships to take forward the development of the products.  "Products" were understood to mean tangible, digital health solutions which would address priority programmatic challenges in TB and/or tobacco control.  The TPPs are expected to be brief documents which define the salient characteristics of these different products.  They will identify optimal and minimal characteristics that the products must have in order to give them a competitive edge over what already exists.  The TPPs will serve as strategic planning tools with which to communicate with an array of users including system developers, investors, implementers and technical partners : by providing more clarity and transparency on what is needed the TPPs will strive to increase the interest of developers in the field.  As originally defined by the FDA, the TPP is a dynamic document that needs to be revisited in the development process ("living document").  The process used recently to develop TPPs for TB diagnostics was regarded as a model which could apply similarly to digital health products for TB and tobacco control.  In the case of TB diagnostics a list of possible solutions and targets was drawn up and then a survey of country representatives, researchers, international organizations, clinicians and funding partners was undertaken.  The TPP documents were then revised through successive iterations of discussions, including at a stakeholder meeting convened by WHO in April 2014[2].  In October 2014 the members of the steering committee which organised the consultation - composed of representatives from WHO, ERS, FIND and ITU - prepared the first draft TPPs for digital health products for TB and tobacco control.  The content of these templates was further informed by a public opinion poll held in January - February 2015.  Replies provided by 196 respondents to this survey were used to guide the prioritization of target products (most popular options polled are presented in Table 1 and Annex 3).  By the time of this consultation, draft TPP documents could thus be made available for the meeting participants to work on in the groups.

## Day 2

### Fresh ideas on bringing new technologies into public health programmes

Matt BERG - Ona, Kenya; Ali HABIB - Interactive Research and Development, Pakistan

The speakers used examples of how state-of-the-art software is being applied in the world of digital health (e.g. data capture on mobiles, capture data on the geolocation of an encounter, integrated patient management systems, eLearning) to improve TB patient outcomes.  The use of open-source solutions facilitates interoperability, customization and use in more countries.  The demand to transmit data to different devices (e.g. connected diagnostics) is expected to grow.  Innovative funding methods, such as for instance spreading implementation costs across different diseases or financing the purchase of hardware through diversified reimbursement schemes, could facilitate more private sector implementation.

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[2] Kik SV, Denkinger CM, Casenghi M, Vadnais C, Pai M. Tuberculosis diagnostics: which target product profiles should be prioritised? European Respiratory Journal. 2014 Aug 1;44(2):537–40.

**Table 1. Top options selected for priority digital health functions in TB & tobacco control, opinion poll, January-February 2015 (see also Annex 3)**

| e/mHealth function | Top options selected under each Function |
|---|---|
| Patient Care, "eDOT" & mCessation | To maintain continuity of care: establishing electronic communications between health-care professionals and patients during their treatment |
| | To maintain continuity of care and make sure patients are not lost to follow up: electronic referrals and confirmation that patient transfers between facilities actually take place |
| | To reduce the burden and cost for both patients and health-care professionals of making sure patients are correctly following their TB treatment: a way to record patients taking their medicines without patients having to go to a health facility |
| Surveillance and Monitoring | To ensure surveillance systems are capturing all TB cases: a simple, lightweight electronic method for clinicians outside national TB programmes to notify TB cases |
| | To help health care workers and public health officials understand and respond to surveillance data: access to automatically-produced standard charts and maps showing trends in TB diagnosis and treatment for any area in a country |
| Laboratory information systems | To speed up communication of results: a system to store data from diagnostic devices and data entry applications and send them to external applications like electronic health records, SMS notifications to clinicians and patients, and stock management applications |
| | To improve speed and reduce transcription errors and the data entry burden: diagnostic devices that are able to send results directly to a laboratory information system and/or to a patient electronic health record |
| eLearning | Electronically delivered training for health-care professionals (web, mobile app, etc.) on, for example, smoking cessation support, warning signs for TB, TB diagnosis, treatment of TB, MDR-TB and XDR-TB, patient support, ethical questions and doctor-patient confidentiality, etc. |
| | Visual instructions aids (for example, short videos on topics such as how to produce a good sputum sample) |
| | Information resources about health conditions, their impact, their diagnosis, treatment and available support services, how family and friends can support people during TB treatment or when stopping smoking, up-to-date policies and clinical guidelines, etc. |

## Zindagi SMS

Shama MOHAMMED - Interactive Research and Development (IRD), Pakistan

Dr MOHAMMED presented the preliminary findings of a trial which has just finished collecting data to evaluate the impact of a two-way SMS medication reminder system for patients with drug-susceptible TB. The intervention consisted in automated SMS reminders sent to the participants daily to which the patient was expected to reply (via SMS or missed call). If there was no patient reply within 2 hours a fresh SMS was re-sent. Patients not responding for a week were followed up by voice calls. The primary outcomes consisted of the standard TB outcomes as reported by clinics as well as self-reported adherence. Over 2,200 persons resident in Karachi were randomised to the intervention or control arms. Nearly 80% of SMS were sent as planned; the failures were largely attributed to system or administrative problems. Of those subjects who were enrolled on the system, 85% responded at least once but the mean response rate overall was 29%: these results suggest that the intervention is feasible but that keeping patients committed over many months is challenging and thus the overall impact wanes over time. There were no statistically-significant differences in the outcomes between the intervention and the control groups. Future work could focus on how such an intervention could be combined with others, such as providing financial incentives. During the discussion it was remarked that the findings bear similarities to those of trials of SMS reminders for antiretroviral treatment (ART). It was also noted that the background success rate was very high in this setting (83%) and thus by inference such an intervention could still have an application in settings where a larger proportion of patients are at risk of interrupting treatment.

## Making eLearning successful – lessons learned from various industries

Daniel STOLLER-SCHAI - Stoller-Schai - Learning Design, Switzerland

The presentation focused on current thinking and approaches to make eLearning more effective, taking advantage of what social media, different platforms and authoring tools have to offer. Successful eLearning means different things to different stakeholders: for instance the *learner* expects the tools to motivate learning, to focus on behaviour-enhancing tasks and to create meaningful and lasting experiences; the *manager* puts more value on having the high-level learning goals achieved; the *trainer* would want the tool to improve participation and results over other available options; and the *developer/designer* expects that state-of-the-art methods used make the delivery more attractive. A framework was presented whereby different eLearning techniques to enhance competencies are grouped under self-directed methods, collaborative learning, social learning and testing/assessments. The intent is to have these techniques "blended". In recent years several industries have been investing in eLearning techniques, convinced of their combined advantage in reducing cost, and increasing effectiveness, user-friendliness, and flexibility. A number of innovative examples were demonstrated by the presenter, such as MOOCs[3], approaches to user-generated content such as video, enhanced eBooks, "gamification", web conferencing and virtual lectures. Communities of practice or learning - modelled on popular communities created for leisure and relationships - have developed and diversified markedly within different disciplines (including health care) over the last few decades. Quizzes and self-testing are becoming more widely used to improve and certify the acquisition of skills (e.g. languages or specific tasks such as assembly-line manufacture). The traditional construct of having classroom teaching followed by individual (home)work is seeing a transformation in which the individual acquires the knowledge primarily via an electronic lecture which is then followed by interaction in a physical or virtual classroom. The presenter concluded that eLearning efforts should start with a clear vision and analysis of target groups, learning goals, expected results and constraints; design a learning experience which

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[3] MOOC stands for "massive open online course", which is aimed at unlimited participation and open access to users via the web (*adapted from Wikipedia*)

engages the learners; and exploit approaches which are likely to be feasible (in terms of technology, resources and culture). Some discussion on how to reduce on dropout rates in eLearning efforts followed.

## Strengthening the integration of TB and tobacco control in primary care through ICT tools

Dongbo FU - WHO/PND, Switzerland

Dr FU presented the perspective of WHO's Tobacco Free Initiative (TFI) on opportunities in primary health care settings for the large-scale integration of both TB and tobacco efforts, exploiting digital health tools. The evidence for the link between both active and passive tobacco smoking and TB infection, disease, and the unfavourable outcome of treatment in TB patients provided the basis for this approach. Given that up to about one third of patients using primary health care services may have respiratory conditions, the patient-centred Practical Approach to Lung Health (PAL) has the potential to reach many persons with both conditions of interest. The proposed entry points would have dual focus: on TB patients who had tobacco dependence (providing brief advice, intensive follow-up support and pharmacological interventions), as well as administrative (making clinics smoke-free and promoting tobacco dependence management in the health services). Country examples were provided (Cambodia, India, Nepal, the Philippines) to illustrate the effect of PAL interventions in primary health care. Digital health could facilitate a number of these processes, such as using electronic medical records for improved integration of tobacco activities in TB care and for M&E, use of mobile phones and internet to enhance quitline services and communication between patients and carers, and eLearning to update and train primary health care practitioners on TB, tobacco and PAL. In the subsequent discussion some practical difficulties were raised about how to deal with smoking in TB hospitals given that patients usually face long admissions during which they are idle and the creation of smoking rooms could actually increase nosocomial infections, particularly in cold climates.

## Reports of the workstreams

The four groups reported on the discussions within their respective workstreams in Day 1. The contents of these reports were summarised in draft presentation documents. In the weeks following the consultation the TPPs were developed further (see Annex 4 for a summary of the TPPs by late April 2015). A more finalised version of the first run of the TPPs will be launched at the ERS International Congress at the end of September 2015 following further consultation.

## Moving from e/mHealth proof of concept studies to national scale: a multi-stakeholder approach

Garrett MEHL - WHO/RHR, Switzerland

This concluding presentation focused on how findings from studies could be used effectively to implement national-scale interventions. Dr MEHL pointed out that resource-constrained programmes are particularly interested to invest in interventions which are proven to maximize health impact. In development, ICT has a role to increase effectiveness and/or efficiency of interventions. ICT could be usefully applied to overcome commonplace barriers to the implementation of interventions of known efficacy, such as by improving the demand for services, ensuring greater compliance to best practice guidelines, averting stockouts of consumables, and optimising the deployment of health professionals. The presenter then explained how an innovations "lifecycle" typically progresses and the critical points that mark its pathway as the solution matures. Expectations of a novel product are typically very high at the start but then wane to a more realistic level as experience in its use increases. Piloting of interventions is necessary ahead of larger scale roll outs : the problem has been that a multitude of eHealth and mHealth projects have failed to advance beyond the proof-of-concept stage. As the "lifecycle" progresses, the dimension for which evidence is key also evolves. In the early phases it is important for prospective users to be convinced of

the functionality of a solution if they are to consider it a feasible option; over time this gives way to other considerations on its usability and on its effectiveness/efficiency over other existing options. This evolution impacts upon the methods used to build evidence. Three useful perspectives for implementation were then outlined. The C.O.R.R.E.C.T mnemonic provides a rule of thumb to assess the likelihood that an intervention can be implemented at large scale (Box 2). The WHO M.A.P.S. tool is a set of instruments for measurement and planning mHealth implementation. And a cascading model was used to illustrate how mHealth strategies could be operationalized within universal health care[4]. Global inventories of digital health projects, such as mREGISTRY.org, could serve as valuable resources for users to share, access and emulate tools.

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Box 2 : "CORRECT" - attributes of "scalability"[5]

**Credible** : based on sound evidence and/or advocated by respected persons or institutions
**Observable** : potential users can see the results in practice
**Relevant** : to persistent or sharply-felt problems
**Relative advantage** : over existing practices to convince potential users of the balance in cost to benefit
**Easy** : to install and understand, rather than complex and complicated
**Compatible** : with the potential users' established values, norms and facilities; fits well into the practices of the national programme
**Testable** : prospective users can observe the intervention on a small scale prior to large-scale adoption

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## What happens after tonight : next steps and milestones from now to the end of 2015 and beyond

Mario RAVIGLIONE - WHO/GTB, Switzerland; Giovanni Battista MIGLIORI - ERS, Switzerland

Dr RAVIGLIONE thanked all the participants for the discussion. He acknowledged that without the generous support of the ERS this consultation would not have been possible and praised the Society for its vision to invest in digital health for TB and tobacco control. The leadership of the ERS has shown concrete commitment to the aims of this meeting. The presentations have been of high standard and were extremely useful in guiding the discussions on what both the established and the newly emerging evidence is indicating. The preliminary results on the first large-scale RCTs from low-income settings on SMS reminders for TB treatment have been valuable; the findings will help focus better resources when they are scarce. Clearly, more evidence will be needed to investigate the performance of similar interventions under a more diverse set of conditions and patient groups, as well as to test out eHealth and mHealth interventions other than SMS reminders and adherence (e.g. VOT). There are many potential applications of digital health that are intuitive and are an extension of what computers help workers do better and faster today. These include eLearning techniques and methods for collecting data via mobiles. Such technologies need to continue being rolled out at scale. Whenever it will release new guidelines, reports, toolkits or information products, the Global TB Programme will in future aim to improve uptake by making the contents of these documents available in different electronic media besides standard .pdfs. It is important that health professionals keep abreast of the state-of-the-art of these technologies to improve their work. The 4 working groups were effective in bringing together experts with very different profiles and backgrounds to enrich the mainstream approaches with fresh ideas on how to improve the integration of TB and tobacco control efforts. The progress on the target product profiles is an encouraging result of this successful interaction over a very brief period of time. Dr RAVIGLIONE announced that WHO's

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[4] Mehl G, Labrique A. *Prioritizing integrated mHealth strategies for universal health coverage*. Science. 2014 Sep 12;345(6202):1284–7.

[5] adapted from *Nine steps for developing a scaling-up strategy.*Geneva, World Health Organization. 2010

Global TB Programme will now establish a task force to move the current discussions forward, to give more substance to the TPPs, and to support the implementation of digital health initiatives in countries. A strategic document based on the continuation of the work catalysed by the consultation will be prepared with the ERS later this year.

Dr MIGLIORI, on behalf of the ERS, thanked all the participants and WHO for convening the consultation. He welcomed the next steps being proposed and looked forwards to supporting the efforts and the spirit of the participants of this consultation in the coming months, the support to projects in Europe and outside, the events planned on the same theme at the ERS International Congress in Amsterdam (26-30 September 2015) including the launch of the strategic document, and further activities thereafter.

## Abbreviations & Acronyms

| | |
|---|---|
| ART | Antiretroviral treatment |
| ERJ | European Respiratory Journal |
| ERS | European Respiratory Society |
| ICT | Information & communication technology |
| ITU | International Telecommunications Union |
| DOT | Directly observed treatment |
| eDOT | Electronic directly observed treatment |
| EMR | Electronic medical record |
| FDA | US Food and Drug Administration |
| FIND | Foundation for innovative and new diagnostics |
| GSM | Global System for Mobile Communications |
| GTB | WHO's Global TB Programme |
| LSHTM | London School of Hygiene and Tropical Medicine |
| LTBI | Latent tuberculosis infection |
| M & E | Monitoring and evaluation |
| mCessation | Mobile-device mediated tobacco smoking cessation |
| MDR-TB | Multidrug-resistant tuberculosis |
| MOOC | Massive open online course |
| NCD | Non-communicable diseases |
| PAL | Practical Approach to Lung Health |
| PDA | Personal Digital Assistant |
| PMDT | Programmatic management of drug-resistant TB |
| PND | WHO's Department for the Prevention of non-communicable diseases |
| RCT | Randomised controlled trial |
| RHR | WHO's Department of Reproductive Health and Research |
| SDG | Sustainable Development Goals |
| SMS | Short message service |
| TB | Tuberculosis |
| TFI | WHO's Tobacco Free Initiative |

| TPP | Target product profile |
|---|---|
| USAID | United States agency for international development |
| VOT | Virtual (video) observed therapy |
| WHO | World Health Organization |
| XDR-TB | Extensively drug-resistant TB |

## Annex 1 - Agenda

| Time | Topic | Speaker |
|------|-------|---------|
| **Day 1 (Co Chair: Matt BERG Co Chair : Dennis FALZON)** | | |
| 9:00 - 9:20 | Welcome Remarks | Elisabeth BEL<br>Mario RAVIGLIONE<br>Douglas BETTCHER |
| 9:20 - 9:30 | Conceptual framework for the application of e/mHealth in TB and tobacco control and meeting objectives | Dennis FALZON<br>Dongbo FU |
| 9:30 - 9:50 | Keynote Speech 1 EVIDENCE<br>- Interventions for tobacco and TB control delivered by mobile phone<br>- Effectiveness of electronic reminders to improve medication adherence in tuberculosis patients: a cluster-randomised trial | Caroline FREE<br>James LEWIS (via video link) |
| 9:50 - 10:15 | Keynote Speech 2 SCALE<br>translating mHealth evidence to scale | Richard LESTER<br>Sameer PUJARI |
| 10:15 - 10:30 | Break | |
| 10:30 – 10:45 | ALLIANCES<br>*Be He@lthy, Be Mobile* : a joint WHO/ITU initiative | Hani ESKANDAR<br>Roxana TINOCO |
| 10:45-11:15 | Country experience in digital health for TB<br>● Video observed therapy for tuberculosis (UK)<br>● e/mHealth for tuberculosis (Rep of Moldova)<br>● Implementation of electronic tools and cell phones for PMDT programme (Bangladesh)<br>● eLearning to improve TB management (Georgia) | Alistair STORY<br>Viorel SOLTAN<br>Paul DARU<br><br>Tamar GABUNIA |
| 11:15-11:30 | Working in Groups : setting priority target product profiles for digital health in TB/tobacco control & promoting country scale-up<br>Workstream 1: Patient care, "eDOT" & mCessation<br>Workstream 2: Surveillance and monitoring<br>Workstream 3: Laboratory information systems<br>Workstream 4: eLearning | Hazim TIMIMI<br>Claudia DENKINGER |
| 11:30 – 12:30 | 1. Identifying the priority products for future investment in each of the 4 Workstreams of e/mHealth for TB / tobacco control | |
| 12:30 – 13:30 | LUNCH | |
| 13:30 – 15:30 | 2. Drafting target product profiles for each priority product | |
| 15:30 – 16:00 | Break | |
| 16:00 – 17:30 | 3. Successful partnering to take forward the development of products | |
| 17:30 - 18:00 | Groups prepare reports for Day 2 | |

| Day 2 (Co Chair: Alistair STORY Co Chair : Christina GRATZIOU) | | |
|---|---|---|
| Time | Topic | Speakers |
| 9:00 - 9:20 | Keynote Speech 3 INNOVATION<br>Fresh ideas on bringing new technologies into public health programmes | Matt BERG<br>Ali HABIB |
| 9:20 - 9:30 | Zindagi SMS | Shama MOHAMMED |
| 9:30 - 9:55 | Keynote Speech 4 eLEARNING<br>Making eLearning successful – lessons learned from various industries | Daniel STOLLER-SCHAI |
| 9:55 - 10:15 | Strengthening the integration of TB and tobacco control in primary care through ICT tools | Dongbo FU |
| 10:15 - 10:30 | Break | |
| 10:30 - 11:15 | Reports of Group 1 | Facilitator / rapporteur |
| 11:15 - 12:00 | Reports of Group 2 | Facilitator / rapporteur |
| 12:00 - 12:30 | Discussion | Christina GRATZIOU |
| 12:30 – 13:30 | LUNCH | |
| 13:30 - 14:15 | Reports of Group 3 | Facilitator / rapporteur |
| 14:15 – 15:00 | Reports of Group 4 | Facilitator / rapporteur |
| 15:00 - 15:30 | Discussion | Alistair STORY |
| 15:30 – 15:45 | Break | |
| 15:45 – 16:00 | Rounding up the discussion on all groups | Alistair STORY |
| 16:00 – 16:30 | Moving from e/mHealth proof of concept studies to national scale: a multi-stakeholder approach | Garrett MEHL |
| 16:30 – 16:45 | What happens after tonight : next steps and milestones from now to the end of 2015 and beyond | Mario RAVIGLIONE<br>Giovanni Battista MIGLIORI |

## Annex 2 - List of participants

| Participants | Affiliation |
| --- | --- |
| Elisabeth BEL | European Respiratory Society, Switzerland |
| Fernando MARTIN | European Respiratory Society, Switzerland |
| Carlos Jimenez RUIZ | European Respiratory Society, Switzerland |
| Giovanni Battista MIGLIORI | European Respiratory Society, Switzerland |
| Pascal KUROSINSKI | European Respiratory Society, Switzerland |
| Stefano ALIBERTI | European Respiratory Society, Switzerland |
| Christina GRATZIOU | European Respiratory Society, Switzerland |
| Richard LESTER | University of British Columbia, Canada |
| Caroline FREE | London School of Hygiene and Tropical Medicine, UK |
| James LEWIS (video link) | London School of Hygiene and Tropical Medicine, UK |
| Matt BERG | ONA, Kenya |
| Jessica ELF | Johns Hopkins University, US |
| Sevim AHMEDOV | USAID, US |
| Janet PHILLIPS | USAID, US |
| Mohammed YASSIN | The Global Fund to Fight AIDS, Tuberculosis and Malaria, Switzerland |
| Evan LEE | Eli Lilly MDR Partnership, Switzerland |
| Malcolm Martiatu FRANCO | Eli Lilly MDR Partnership, Switzerland |
| Matthew GUILFORD | Telenor Health, Norway |
| Aya CALDWELL | Novartis Foundation, Switzerland |
| Eric ADAM | Otsuka Pharmaceutical, Switzerland |
| Maik STUMPF | Janssen BTV, Belgium |
| Daniel STOLLER-SCHAI | Stoller-Schai - Learning Design, Switzerland |
| Ehsan LATIF | UNION, Paris |
| Emmanuel ANDRE | Université catholique de Louvain, Belgium |
| Rustam SHAKHMAEV | TB ICT consultant, Tajikistan |
| Bill COGGIN | CDC (TB/HIV), US |
| Claudia DENKINGER | FIND, Switzerland |
| Tobias BROGER | FIND, Switzerland |
| Nicolas DI TADA | InSTEDD, US |
| Chris ISAAC | FIND, Switzerland |
| Steven UGGOWITZER | c/o FIND, Switzerland |
| Kristians KORNS | Cepheid, France |
| Daniela CIRILLO | Global TB Laboratory Initiative, Italy |
| Aamir KHAN | Interactive Research & Development, Pakistan |
| Ali HABIB | Interactive Research & Development, Pakistan |
| Shama MOHAMMED | Interactive Research & Development, Pakistan |

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|---|---|
| Jeff TAKLE | GxAlert, US |
| Gustavo DO VALLE BASTOS | MSH, Brazil |
| Lal SADASIVAN | PATH, US |
| Julia TAINIJOKI-SEYER | World Medical Association, France |
| Vu Dinh HOA | National Pharmacovigilance Centre, Viet Nam |
| Le Van HOI | National TB Programme, Viet Nam |
| Sabira TAHSEEN | National Reference Laboratory, Pakistan |
| Paul DARU | University Research Co, Bangladesh |
| Kirankumar RADE | Central TB Division, India |
| Alistair STORY | Find & Treat, UK |
| Viorel SOLTAN | PAS, Moldova Rep |
| Alena SKRAHINA | National TB Programme, Belarus |
| Tamar GABUNIA | University Research Co, Georgia |
| Roxana TINOCO | Ministry of Foreign Affairs and Culture, Costa Rica |
| Stella VAN BEERS | KIT, The Netherlands |
| Edine TIEMERSMA | KNCV, The Netherlands |
| Dalene VON DELFT | TB Proof, South Africa |
| Tsira CHAKHAIA | Georgia |
| Alex SILVERSTEIN | International Diabetes Federation, UK |
| Subhi QURAISHI | ZMQ Development, India |
| Hani ESKANDAR | International Telecommunications Union, Switzerland |
| Suzanne HODGKINSON | International Telecommunications Union, Switzerland |
| Jacob CRESWELL | TB REACH, Switzerland |
| Eyerusalem NEGUSSIE | WHO HIV |
| Diana ZANDI | WHO KER |
| Garrett MEHL | WHO RCP |
| Mario RAVIGLIONE | WHO TB |
| Diana WEIL | WHO TB |
| Fraser WARES | WHO TB |
| Ernesto JARAMILLO | WHO TB |
| Dennis FALZON | WHO TB |
| Medea GEGIA | WHO TB |
| Monica DIAS | WHO TB |
| Wayne van GEMERT | WHO TB |
| Hazim TIMIMI | WHO TB |
| Mukund UPLEKAR | WHO TB |
| Alberto MATTEELLI | WHO TB |
| Kianoush DEHGHANI | WHO TB |
| Dick MENZIES | WHO TB |
| Douglas BETTCHER | WHO Tobacco |

| | |
|---|---|
| Dongbo FU | WHO Tobacco |
| Sameer PUJARI | WHO Tobacco |
| Virginia ARNOLD | WHO Tobacco |
| Olav POPPE | WHO Informatics |
| Alison CLEMENTS-HUNT | WHO DCO |
| Edsel GUZMAN | WHO DCO |
| Tom HIATT | WHO Regional Office for the Western Pacific, Philippines |
| Andrei DADU | WHO Regional Office for Europe, Denmark |
| Valentin RUSOVICH | WHO Country Office, Belarus |

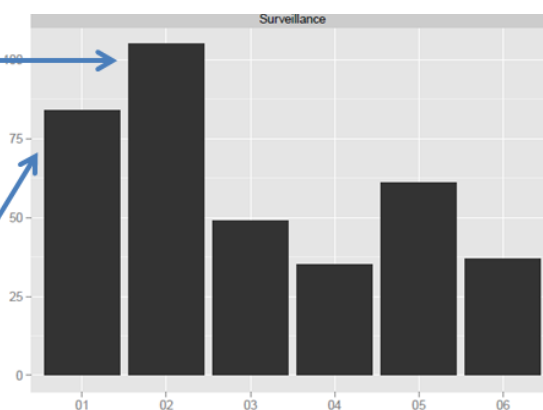# Annex 3 - Top options selected for the poll on e/mHealth for TB & tobacco
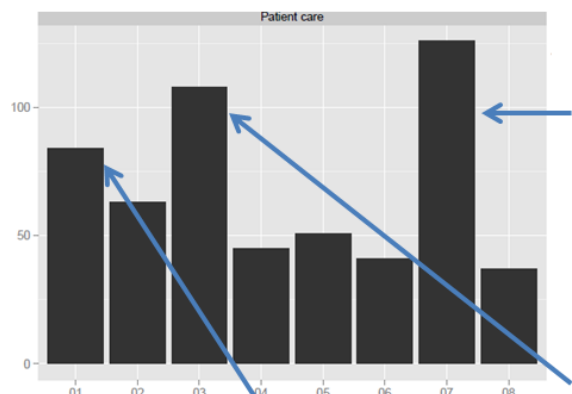


**To maintain continuity of care:** establishing electronic communications between health care professionals and patients during their treatment

**To maintain continuity of care and make sure patients are not lost to follow up:** electronic referrals and confirmation that patient transfers between facilities actually take place

**To reduce the burden and cost for both patients and health care professionals of making sure patients are correctly following their TB treatment:** a way to record patients taking their medicines without patients having to go to a health facility

**To ensure surveillance systems are capturing all TB cases:** a simple, lightweight electronic method for clinicians outside national TB programmes to notify TB cases

**To help health care workers and public health officials understand and respond to surveillance data:** access to automatically-produced standard charts and maps showing trends in TB diagnosis and treatment for any area in a country

To speed up communication of results: a system to store data from diagnostic devices and data entry applications and send them to external applications like electronic health records, SMS notifications to clinicians and patients, and stock management applications
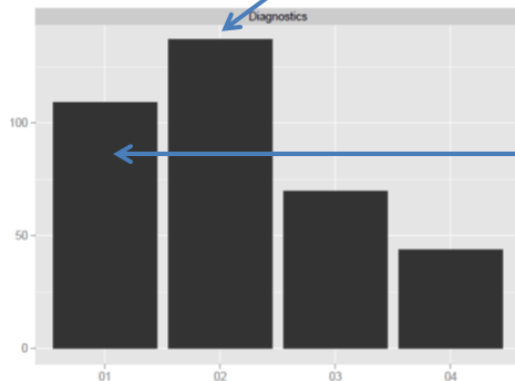
To improve speed and reduce transcription errors and the data entry burden: Diagnostic devices that are able to send results directly to a laboratory information system and/or to a patient electronic health record



Electronically delivered training for health care professionals (web, mobile app, etc.) on, for example, smoking cessation support, warning signs for TB, TB diagnosis, treatment of TB, MDR-TB and XDR-TB, patient support, ethical questions and doctor-patient confidentiality, etc.

Visual instructions aids (for example, short videos on topics such as how to produce a good sputum sample)

Information resources about health conditions, their impact, their diagnosis, treatment and available support services, how family and friends can support people during TB treatment or when stopping smoking, up-to-date policies and clinical guidelines, etc.
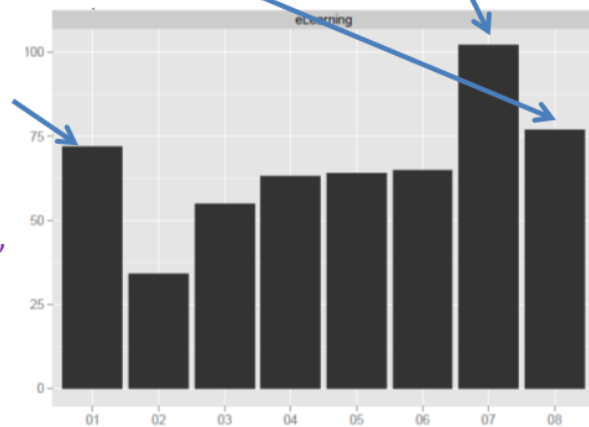
## Annex 4 - Summary of the draft Target Product Profiles for digital health in TB and tobacco control *(as on 17 April 2015)*

| *Function* | *Name* | *Short description* |
|---|---|---|
| **Patient care** | **Video treatment support (VOT) for TB patients via mobiles** | The end product will exploit video communication between patient and health care professional, transmitted via internet live or self-recorded, primarily employing smartphones, to enhance patient support.  It will allow the caregiver to document the self-administration of daily medication remotely.  VOT could limit the number of clinic visits requested of a patient in the course of treatment.  The VOT interaction will not be limited to observing the act of taking TB drugs but also create opportunities to interact on associated problems, especially adverse drug reactions; comorbidities (e.g. diabetes care) and health promotion for risky behaviour (e.g. smoking cessation and substance use). |
| | **eHealth portal for TB patients** | In order to improve continuity of care and adherence, a single web interface will guide the TB patient and health care provider to locate different health services via a mobile device or desktop. The TPP will specify how to bring together different products and services to improve patient adherence to TB treatment and improve outcomes of concurrent diseases or important health risks - particularly tobacco smoking - to the individual patient. |
| **Surveillance & monitoring** | **Graphic dashboards for TB** | Health care workers will be able to summarise the data that they collect into graphical depictions and maps showing trends in TB diagnosis and treatment, and patterns of risk factors - such as tobacco smoking in adults by sex - for any area/facility in a country.  This will help them focus better on the impact of the public health efforts and also stimulate additional analysis (e.g. space/time distribution of cases).  Similar functionalities are already built into some systems and software; however, the TPP will guide the software developers on what to present to users, how best to derive and stratify indicators, and potential for novel analysis, particularly the spatio-temporal patterns. |
| | **eNotify TB** | Clinicians working at facilities outside of the national TB programmes (including private sector, large public and/or university hospitals) will be able to notify TB cases using a simple, lightweight electronic system.  This will improve knowledge of the epidemic.  The content can include reference to key risks such as tobacco smoking.  TPP will describe how this functionality will interoperate with mainstay systems coordinated by the public sector for TB surveillance. |

| Function | Name | Short description |
|---|---|---|
| **Surveillance & monitoring** (continued) | ePV for TB | In a context of increasing use of new and repurposed TB drugs and novel regimens, pharmacovigilance (PV) gains in importance to safeguard patient health.  This will encompass active PV (namely cohort event monitoring) and patient-initiated reporting of adverse reactions.  The TPP will define how systems need to be developed and interact with existing electronic medical records to ensure adequate surveillance for drug-related harms in patients for whom newer treatments are indicated. |
| **Laboratory information systems & connected diagnostics** | TB diagnostic device connectivity | Bottlenecks in data management – real and potential - should be addressed alongside the introduction of new diagnostics.  For diagnostic systems to make a measurable impact on patient care they should be able to communicate through a standardized digital interface and to interact with mobile devices regardless of the income-level of the country.  The TPP will define the connectivity requirements of diagnostic devices and the criteria required for them to operate in unison.  It will represent one step within a chain of operations aimed at improving the management of laboratory data from the point of generation to storage to transmission of results to the user. |
| **eLearning** | eLearning apps for TB patients | An innovative resource platform is aimed for in order to enhance patient learning on TB and health risks - particularly tobacco use - and ultimately improve outcomes.  The TPP will describe how novel techniques – including games and social media – can be integrated with traditional methods of transferring knowledge so that patients understand key aspects of their care, including adverse effects of treatment and informed consent. |
|  | eLearning apps for TB health-care workers | A series of web-based, problem-oriented, self-directed learning applications will update the primary care providers on the latest recommendations in TB & MDR-TB case management and associated health risks, particularly tobacco use.  The TPP will describe the characteristics that applications need to have in order to best avail the health care providers of information important for patient care (e.g. composition of treatment regimens and management of adverse reactions).  It will also define how such apps can work with different platforms, especially the various operating systems used by mobile phones. |