

Ensuring that mHealth applications provide essential healthcare information for citizens in low resource settings

Introduction

Citizens in low resource settings need basic healthcare information to prevent and manage disease and injury. In these settings, unlike in high-income countries, people may have little or no access to health education, and little or no access to a health worker in case of need, and therefore basic information is even more important. Many – maybe most - premature deaths in children, women and men could have been avoided by the simple application of healthcare knowledge with simple and inexpensive interventions that are often locally available. Lack of access to basic healthcare information continues to be a major contributing factor to death and suffering.

The use of mobile communication technology is growing hugely in low resource settings. For example in 1999 only 10 % of the African population had mobile phone coverage, by 2008 this had risen to 60 % (ref 1) and a recent survey (www.afrobarometer.org) indicates that by 2012 use of mobile phones had attained an average of 84% of the population across 34 African countries. This is opening up a wide range of actual or potential health-related uses of mobile phones for such settings (see e.g. refs 2, 3, 4), not least the opportunity for major advances in the provision of essential – often life-saving – practical information about health and healthcare to the poorest 2 billion of the world's population who typically have low access to health services but increasing access to mobile phones. Major mobile handset manufacturers and network operators are beginning to grasp this opportunity. Indeed the global campaign Healthcare Information for All (HIFA) has challenged them to provide essential healthcare knowledge on mobile phones without charge (see www.hifa2015.org/the-first-hifa-smart-goal-mobile-healthcare-information-for-all).

Notwithstanding this encouraging background, the successful delivery of mHealth programmes in low resource settings faces particular challenges (see e.g. refs, 5, 6, 7 ,8). One challenge is that most mobile phones in low resource settings have been basic phones that can only accommodate voice and SMS text messages. A recent survey by Kartzinel and Hagar (ref 9), conducted on behalf of HIFA, which **surveyed nearly 1700 mHealth projects, found numerous successful examples of mHealth projects based on SMS, but very few: less than 10 -- under 1% -- that provided more substantive information that could be used, as and when required, by people in low resource settings to obtain essential, accessible and actionable information about health and health care.**

However, the situation is changing rapidly, and feature phones (basic phones that can accommodate an SD card, carrying video and other media) are becoming ubiquitous. Smartphones also are becoming more and more affordable - a smartphone priced at under \$40 has recently been released in India - which not only will rapidly spread their use (the GSMA have recently estimated that by 2020 four out of every five smartphone connections will come from the developing world, see ref 10) but should also reduce the fear and risk of theft or loss, identified by health workers as a significant current obstacle to their use. More and more people are able to access the internet free (via wi-fi), or at low cost, continuously or at least intermittently. There is a huge potential for new,

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media-rich applications to meet the information needs of citizens in low-resource settings.

The review by HIFA also highlighted the absence of a simple assessment tool that could distinguish mHealth projects and products with the potential to put relevant, reliable healthcare information into the hands of citizens, to be used as and when needed. At present it appears that whilst interest in assessment of mHealth applications is growing (see e.g. refs 11, 12) most thinking is focused on assessment of applications designed for use in high rather than low resource settings. HIFA is therefore developing a tool aimed specifically at use for **assessing mHealth applications focused on provision of healthcare information in low resource settings**: the mHIFA Assessment Tool.

This article proposes some appropriate criteria for use by the mHIFA Assessment Tool and describes how these could be operationalised in an assessment template that uses simple “traffic light” indicators, and illustrates its use with examples drawn from the above-mentioned survey. From this it draws some conclusions about what appears most needed in introducing new applications or to improve existing ones.

Requirements for action-oriented healthcare information

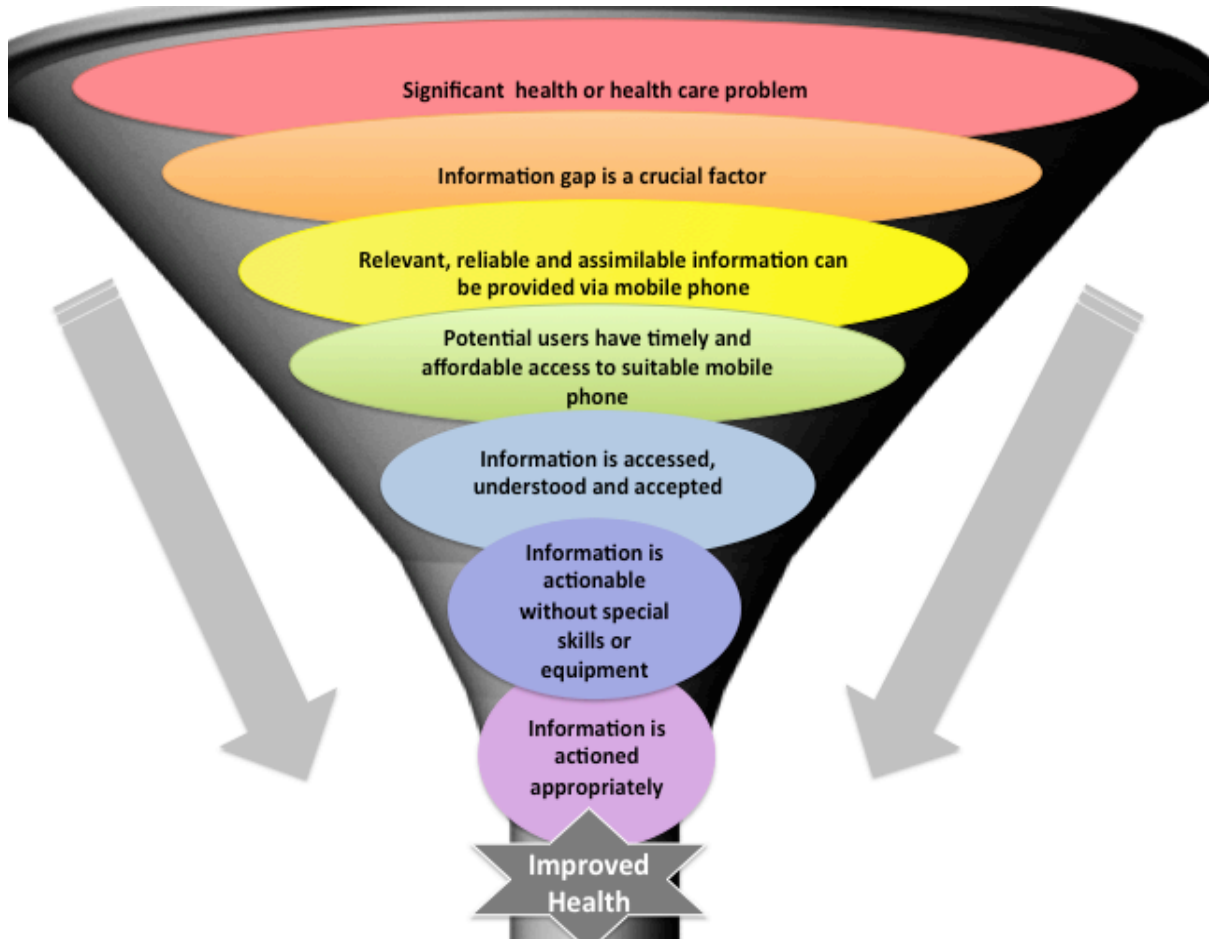
The provision of essential healthcare information to citizens is one piece of a complex jigsaw for empowering people to care better for themselves and their families. The jigsaw has been characterised by HIFA by the acronym SEISMIC (skills, equipment, information, structural support, medicines, incentives and communication facilities). Clearly, the more complete the jigsaw and the better its pieces fit together, the greater the chances of people taking appropriate and effective steps in caring for their health. The acronym was originally developed to describe the range of basic needs of health workers, but most if not all are applicable also to citizens in their role as 'healthcare providers'. It could be argued that it is particularly important to meet needs such as information and communication facilities for citizens living in low-resource settings, on the basis that (unlike in high-income countries) they may not have access to a trained health worker.

Taking that wider picture into account is important, but for mHealth the initial requirement is to focus on some more proximate factors. These will include not only technological but also cognitive and behavioural factors related to the comprehension, acceptance and use of information --- for example information may not be accepted and used unless it is trusted and seen to be culturally appropriate (see e.g. refs 13, 14) . It will be important to draw upon current knowledge on what drives health-related behavior change, to ensure that information is acceptable and actionable.

The funnel diagram in **Figure 1** below suggests a series of such factors, which can be regarded as a succession of filters *all* of which need to be passed through for a successful impact to be achieved. (This focuses on **criteria of particular relevance to achievement of the HIFA aims and vision** i.e. that *“every person and every health worker will have access to the healthcare information they need to protect their own health and the health of those for whom they are responsible”*; there are of course wider criteria, such as data security and privacy, that need to be considered when assessing mHealth applications.)

FIGURE 1

A funnel diagram showing filters through *all* of which a mHealth application needs to pass to achieve HIFA aims



A criterion set for mHealth information applications in low resource settings

From the above funnel diagram we can identify the following criteria and suggest some associated components, as in the box below.

- **Significance of the health problem(s):** Is the application focused on a significant health or healthcare problem - a widespread serious condition, or an emergency or urgent need?
- **Appropriateness of the targeting:** is the application aimed at use in low resource settings or by low income or other priority groups e.g. mother and child, health educators?
- **Value of the information:** Is the information relevant to users' needs for addressing the health problem; is it reliable; can it be easily related to practical action?
- **Ease of assimilation of the information:** is the information presented in an appealing and easy to understand way such as a video or voice clips; is it culturally appropriate and available in local language(s)?
- **Availability of the application:** is the application available across several regions or countries; is it available free to the user?
- **Technological accessibility of the application:** does it have a simple and intuitive user interface, is it accessible on a basic or feature phone; will it work "offline"; will it work on multiple operating systems; is it pre-loaded?

Clearly there is scope to add to or amend these criteria, for example some might prefer to take financial cost as a separate dimension.

A simple assessment template using "traffic light" indicators

To allow easy application of the set of criteria for assessment purposes a simple "traffic light" indicator system is proposed, as shown in **Figure 2** below. For each component of each criterion, attributes are described *that broadly indicate increasing "fit" of an application to the achievement of HIFA aims*. The attributes (of which there are generally three, occasionally two or four) are coded red, amber, or green, with **red** indicating poor alignment to HIFA aims, **green** a good fit and **amber** an intermediate match. [The coding in figure 2 of different attributes in relation to HIFA aims could be usefully discussed. For some, there are no right or wrong answers.] The attributes and coding are presented as a general guide, and an amber or red code for any individual mHealth project in regard to HIFA aims or product does not necessarily imply inferiority in regard to other possible objectives: the value of any project or product is most closely related to whether it meets the specific needs of its defined target audience.

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FIGURE 2
A template for assessing mHealth applications in relation to HIFA aims

| CRITERION | COMPONENTS | ATTRIBUTES | mHIFA RATING GUIDE |
|--|--------------------------------|---|--------------------|
| SIGNIFICANCE OF THE HEALTH PROBLEM(S) | URGENCY | Chronic care | Yellow |
| | | Acute care | Yellow |
| | | Emergency care /first aid | Green |
| | SEVERITY | Minor health or healthcare problems | Red |
| | | Moderate health or healthcare problems | Yellow |
| | | Serious health or healthcare problems | Green |
| APPROPRIATENESS OF THE TARGETING | TARGET AUDIENCE | General Public | Yellow |
| | | Health workers and educators | Yellow |
| | | Carers (mothers, young people) & children | Green |
| | COUNTRY(IES) OF USE | High income | Red |
| | | Medium Income | Yellow |
| | | Low income | Green |
| VALUE OF THE INFORMATION | RELIABILITY | Poor/Unknown | Red |
| | | Moderately accredited source | Yellow |
| | | Well accredited source | Green |
| | RELEVANCE TO USERS' NEEDS | Little relevance to users | Red |
| | | Moderate relevance to users | Yellow |
| | | Essential information for users | Green |
| EASE OF RELATING TO ACTION | Little clear linkage to action | Red | |
| | Moderate linkage to action | Yellow | |
| | Strong linkage to action | Green | |
| EASE OF ASSIMILATION OF THE INFORMATION | INFORMATION FORMAT | Text | Red |
| | | Audio | Yellow |
| | | Picture Video | Green |
| | LANGUAGE(S) | English | Red |
| | | National/Regional | Yellow |
| | | Multilingual/various local | Green |
| AVAILABILITY OF THE APPLICATION | GEOGRAPHICAL PROVISION | Local regions | Red |
| | | National | Yellow |
| | | Supernational | Green |
| | COST TO USER | Full Commercial | Red |
| | | Subsidised | Yellow |
| | | Free | Green |
| TECHNOLOGICAL ACCESSIBILITY OF THE APPLICATION | USER INTERFACE | Basic website | Red |
| | | Website with navigation aids | Yellow |
| | | Tailored mobile app | Green |
| | COMMUNICATION REQUIREMENTS | 2-way (to and from user) | Red |
| | | 1-way (to user) | Yellow |
| | | 1-way (from user) | Yellow |
| | MOBILE PLATFORM | None (offline - pre-loaded or microSD) | Green |
| | | Tablet or PDA | Red |
| | | Smartphone | Yellow |
| | OPERATING SYSTEM | Feature phone | Green |
| Basic phone | | Green | |
| iOS | | Yellow | |
| ADDITIONAL PHYSICAL MEDIA NEEDS | Windows | Yellow | |
| | Android | Green | |
| | Multiple | Green | |
| | Special MicroSD card | Red | |
| | None (material downloadable) | Yellow | |
| | None (material preloaded) | Green | |
| | | Green | |

Illustration of the use of the assessment template

To illustrate the use of the assessment template, six mHealth applications were chosen from those that were identified in the HIFA survey as most relevant to the needs of users in low resource settings for healthcare information and so likely candidates for contributing to achievement of the HIFA aim for every person and every health worker to have access to the healthcare information they need to protect their own health and the health of those for whom they are responsible.

These applications were: HealthPhone; Newborn Care Series; Safe Pregnancy and Birth; OppiaMobile; First Aid (Red Cross); and SmartHealth. Brief details are shown in the box below.

HealthPhone, a project of the Mother and Child Health Education Trust, is a personal video reference library and guide to better health and nutrition practices, for families and communities, including the illiterate, in their language, distributed on mobile phones. www.healthphone.org

Newborn Care Series, from the Global Health Media Project, provides frontline health workers with a suite of videos on low-cost, low-tech life saving interventions, presenting clinical guidelines in a visual form for training and review. www.globalhealthmedia.org/newborn

Safe Pregnancy and Birth, from Hesperian, is a mobile app that provides health information that aims to support women, midwives and health workers to ensure safer pregnancies. www.hesperian.org/books-and-resources/safe-pregnancy-and-birth-mobile-app

OppiaMobile, from Digital Campus, is a mobile app that provides a platform for delivering learning content, largely focused on key health topics for frontline health workers, and includes use of videos, quizzes and with a text-to-voice conversion facility. <https://oppia-mobile.org>

First Aid, from the British Red Cross, is a mobile app that provides advice on everyday first aid situations, using videos, quizzes and step-by-step guides, plus tips for emergency preparedness. www.redcross.org.uk/What-we-do/First-aid/Mobile-app

SmartHealth, an initiative by Mobilium Global and Samsung, is a mobile app that provides information mainly on HIV/AIDS, TB and Malaria and also incorporates a mobile web based symptom checker. It is aimed at enhancing the health, health maintenance, health behaviors of individuals and their communities across Africa. <http://mobilium.com/about-us/october-2013-mobilium-smart-health-app>

The results of assessing these applications against the criteria in Figure 2 are shown in Figures 3a and 3b.

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FIGURE 3a Illustration of application of the assessment template

| CRITERION | COMPONENTS | HealthPhone | Rating | Newborn Care Series (Global Health Media Project) | Rating | Safe Pregnancy and Birth (Hesperian) | Rating |
|--|---------------------------------|--|--------|--|--------|---|--------|
| SIGNIFICANCE OF THE HEALTH PROBLEM(S) | URGENCY | Covers many aspects of chronic and acute care | 3 | Full range of urgency covered | 3 | Includes emergencies | 3 |
| | SEVERITY | Broad and deep coverage of many health problems | 3 | Moderate/emergency problems in pregnancy and childcare , (by definition, no other areas covered) | 2 | A key health issue (though, by definition no other areas covered) | 3 |
| APPROPRIATENESS OF THE TARGETING | TARGET AUDIENCE | Health workers and priority groups. | 3 | Health care workers caring for pregnant women and mothers of young children | 3 | Health workers involved in maternity care | 2 |
| | COUNTRY(IES) OF USE | Focus on low income groups | 3 | Low income | 3 | Information oriented to low income countries | 3 |
| VALUE OF THE INFORMATION | RELIABILITY | Appears very good; approved by various official bodies | 3 | Well accredited sources | 3 | Authoritative | 3 |
| | RELEVANCE TO USERS' NEEDS | Focus is on essential information needs especially for prevention. No symptom checker | 2 | Essential information. No symptom checker. | 2 | Covers key health issues and concerns of user group | 3 |
| | EASE OF RELATING TO ACTION | Most videos strongly action related | 3 | Strong linkage to action | 3 | Strongly action -oriented | 3 |
| EASE OF ASSIMILATION OF THE INFORMATION | INFORMATION FORMAT | Very large video library | 3 | Large video library | 3 | App is text-heavy but has simple illustrative diagrams | 2 |
| | LANGUAGE(S) | Multi lingual (over 70) languages) | 3 | Multilingual - English, Spanish, French, Swahili, Nepali, Khmer | 3 | English and Spanish | 2 |
| AVAILABILITY OF THE APPLICATION | GEOGRAPHICAL PROVISION | Many countries covered | 3 | Supernational | 3 | General? | 2 |
| | COST TO USER | App is free, (except possible data charge for one-off download?) | 3 | Free (except possible data charge for initial download) | 3 | App is free | 3 |
| TECHNOLOGICAL ACCESSIBILITY OF THE APPLICATION | USER INTERFACE | Not an "app" as such, website has huge menu of video downloads, menu navigation may be difficult for some | 2 | Website with navigation aids | 2 | Mobile app, menu very easy to navigate | 3 |
| | COMMUNICATION REQUIREMENTS | All material available off-line | 3 | None (after download) | 3 | Works offline | 3 |
| | MOBILE PLATFORM | Wide range of device types. Some text for basic phones, low-cost feature phone suffices for other materials. | 2 | Smartphone or feature phone | 2 | Needs smart phone or tablet | 2 |
| | OPERATING SYSTEM | Multiple | 3 | Any? | 3 | Android or iOS | 3 |
| | ADDITIONAL PHYSICAL MEDIA NEEDS | All videos are available on microSD or to download. | 2 | None (material downloadable) | 2 | App downloadable | 2 |

FIGURE 3b Illustration of application of the assessment template (ctd)

| CRITERION | COMPONENTS | OppiaMobile (Digital Campus) | Rating | First Aid (British Red Cross) | Rating | SmartHealth (Mobilium) | Rating |
|--|---------------------------------|--|--------|---|--------|--|--------|
| SIGNIFICANCE OF THE HEALTH PROBLEM(S) | URGENCY | Covers many aspects of communicable and non-communicable diseases and care (including antenatal care) and environmental health | 2 | Focused on emergency care/first aid | 2 | Mostly focused on acute; not much on emergency | 2 |
| | SEVERITY | Broad and deep coverage of many health problems | 2 | A range of serious problems | 2 | Focus on just 3 main conditions (HIV, tuberculosis, malaria) | 2 |
| APPROPRIATENESS OF THE TARGETING | TARGET AUDIENCE | Health workers - all material is in form of training courses | 2 | General public, and there is a companion app focused on babies and children | 2 | General Public? Nothing focussed on mother and child | 2 |
| | COUNTRY(IES) OF USE | Low and middle income | 2 | High income (UK focus) | 1 | Information oriented to low and middle income countries | 2 |
| VALUE OF THE INFORMATION | RELIABILITY | Sources appear well accredited | 2 | Well accredited source | 2 | Approved in some sense by Global Fund | 2 |
| | RELEVANCE TO USERS' NEEDS | Essential information | 2 | Essential information | 2 | Information rather general; symptom checker ("isabel") only signposts to elsewhere | 1 |
| | EASE OF RELATING TO ACTION | Strong linkage to action | 2 | Strong linkage to action | 2 | Material very variable in pointing to action | 2 |
| EASE OF ASSIMILATION OF THE INFORMATION | INFORMATION FORMAT | Largely text, but with text to speech conversion facility. Some diagrams. Quizzes. A few videos. | 2 | Largely text, some diagrams and videos, also quizzes and checklists | 2 | App is text-heavy; there are links to a few YouTube videos | 2 |
| | LANGUAGE(S) | English only? | 1 | English only | 1 | English, French, Portuguese, Swahili | 2 |
| AVAILABILITY OF THE APPLICATION | GEOGRAPHICAL PROVISION | Generic, plus Ethiopia | 2 | National | 2 | Pan-African | 2 |
| | COST TO USER | Free | 2 | Free (except possible data charge for initial download) | 2 | App is free (but will be data charges for online use?) | 2 |
| TECHNOLOGICAL ACCESSIBILITY OF THE APPLICATION | USER INTERFACE | Tailored mobile app, easy to navigate | 2 | Tailored mobile app, menu very easy to navigate | 2 | Mobile app, menu easy to navigate | 2 |
| | COMMUNICATION REQUIREMENTS | None(after download) except for progress feedback to trainers | 2 | None (after download) | 2 | Videos and symptom checker both require online access | 1 |
| | MOBILE PLATFORM | Smartphone or tablet | 2 | Smartphone or tablet | 2 | Smartphone or tablet | 2 |
| | OPERATING SYSTEM | Android only? | 2 | Android or iOS | 2 | Android only? | 2 |
| | ADDITIONAL PHYSICAL MEDIA NEEDS | None (material downloadable) | 2 | None (material downloadable) | 2 | Preloaded on Samsung phones and tablets in Africa, downloadable elsewhere | 2 |

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Segmentation of mHealth information applications by type of user and use

The above assessments look at the various applications from the perspective of how well they appear to be aligned to the needs of citizens or health workers in low resource settings to have ready access to essential healthcare information. However, different types of users and use will have somewhat different requirements and it is important (not least for application developers) to be clear about these. There will be a spectrum of uses (with some overlap). A proposed segmentation is:

- use by healthcare workers on their own, for their education, professional development,
- use by such workers when they are with patients or members of the public, to help them advise patients on a health care issue or to educate the public on a health promotion topic,
- use by patients or the public when they are on their own, for self education, for self care, and to help them look after their families..

The table below indicates, for each of the six assessed applications, their apparent focus on each of these three user segments

| Application | Focus on use for health workers own education and development | Focus on use by health workers when with public/patients to help with advice and education | Focus on use by public/patients on their own for self care, family care, and self education |
|--------------------------|---|--|---|
| OppiaMobile | ** | | |
| Safe Pregnancy and Birth | ** | ** | |
| HealthPhone | * | ** | * |
| New Born Care | * | ** | * |
| Red Cross First Aid | | | ** |
| SmartHealth | | | ** |

Conclusions

If mobile handset manufacturers and network operators are truly committed to develop health information applications that will be useful to and valued by the poorest 2 billion of the world's citizens, who are becoming an increasingly important part of their customer base, then they must focus on what users in low-resource settings most need and can easily access and apply. Use of criteria and associated assessment templates along the lines of that described here could assist that focus and help to provide the best foundation for their success. Some useful lessons can already be drawn from the illustrative assessments.

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Firstly, it is instructive to consider why **two of the applications, whatever their merits in general, score much less well than the other four in terms of assessed relevance to the aims of Health Information for All**. One, SmartHealth from Mobilium, is commendably aimed at public use in low resource settings (and has commendably been rolled out by Samsung in Africa) but currently falls short particularly in not being focused on essential, action-oriented, health information needs of key groups, and on requiring online connectivity for accessing much of its content. The other, First Aid from the British Red Cross, looks to be a first-class application for its target audience, speakers of English in a high income country, and is focused on essential, action-oriented, health information, but it is not designed to meet the needs of people in low resource settings. It is not difficult however to see how both these applications could be developed into something more useful for such settings, and it is good to see some initial steps in that direction e.g. SmartHealth has recently been made available in three additional languages.

Secondly, none of the applications assessed above were “*push*” messaging applications, where the recipient and the nature, timing and format of health information is determined by the provider. Such applications are by far the most common type of mHealth application and clearly can make a valuable contribution. However only one such application (mMITRA, a voice-message based application) was identified in the HIFA survey as particularly relevant to HIFA aims. Messaging (especially text-only messaging) has shortcomings in regard to the HIFA aim of empowering people in low-income countries with essential healthcare information on their phones for *them to consult as and when they need it*. **We have therefore focused here on the - as yet less well-developed - “*pull*” applications, where the user decides what information to acquire, as and when they wish.**

Thirdly, as noted above, four of the applications assessed here, HealthPhone, Newborn Care, Safe Pregnancy and Birth and OppiaMobile health training courses, are currently aimed primarily at health care workers, either for their own use or to use in conjunction with those for whom they are caring, and are therefore not really designed for direct use by the public, parents or lay carers. This does not affect their value in contributing to the overall HIFA vision – for which improving access to essential information for health workers is a vital part – but **does highlight a particular gap in provision of mHealth applications for direct use by citizens.**

These three points suggest there are **three major development strands** to be considered for ensuring that mHealth applications provide essential healthcare information in low resource settings:

- (i) improving access to essential information for health workers own education and development.**
- (ii) improving access to essential information for health workers to use in conjunction with patients and the public.**

These two strands overlap (although some greater clarity about what material is intended for which of the two uses would seem helpful) and for both of these the main challenge is that applications such as those considered above (HealthPhone, Newborn Care, Safe Pregnancy and Birth, and OppiaMobile health training courses) should be further

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developed, especially in regard to adding content and languages appropriate for a wider range of countries and cultures, taken up by mobile phone enterprises, and rolled out as far and as fast as possible.

(iii) improving direct access to essential health information for citizens, patients and lay carers.

This strand appears to be the least well developed, yet is the most relevant to the aim of providing citizens in low resource settings with essential, accessible and actionable information about health and health care as and when they need it. Indeed at the time of writing (late 2014) ***there still appears to be no mobile phone application providing off-line access to essential, actionable, knowledge on a range of acute health care situations, primarily focused on direct use by citizens in low resource settings.***

Some of the assessed applications could make a significant contribution towards filling this gap this by some relatively modest enhancements, for example :

- the Red Cross First Aid app could be produced in an additional version(s) *designed for use in low resource settings*
- the Hesperian Safe Pregnancy and Birth app could be extended to *include a version that was aimed directly at public/patients* (as a companion app to the current one aimed at health workers)
- the HealthPhone and Newborn Care video libraries could be used to produce a version that was *more suitable for use by public/patients on their own*, through appropriate selection/adaptation/extension of their material and packaging it as a mobile app* with a simple user interface
- the SmartHealth app could produce an *off-line version* and revise its content to be *more focused on essential, action-oriented, health information needs of key groups*

In the longer term the need is to develop applications, purpose built for use in low resource settings, that combine the positive features of applications such as those assessed here, but avoid the characteristics that make them less well fitted to the provision of health care information for all. The assessment criteria in Figure 2 and the associated assessments in Figures 3a and 3b point the way to what off-line apps of this type could look like in terms of :

- health content – priorities could be health education, maternal and reproductive health, child health, and first aid
- format of material – full use of pictorial and video-based material with audio (voice clips and automated text-to-speech conversion) for use where literacy is low and/or phones that can show video are not available
- user interface – simple and intuitive “front end”, with easy navigation and icons for use in low literacy settings;
- technical platform – applications aimed at health workers can probably already assume availability of feature/smartphones or tablets; applications for direct use by citizens and patients will increasingly be able to do as such devices rapidly become

* It is understood that there is an “app” for HealthPhone, but that it is not yet generally available, so it has not yet been included in this assessment

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less expensive and more widespread.

Developing such applications should be a co-production involving citizens, patients, carers, health workers, mobile phone enterprises and other stakeholders – including international bodies such as the WHO.

Producing and making freely available such applications to directly empower citizens in low resource settings with essential, accessible, actionable, healthcare knowledge as and when they need it, could open up a new chapter in global health.

Geoff Royston
December 2014

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