Mobile Healthcare Information for All

Assessment of mHealth applications for their potential to provide essential healthcare information for citizens in low resource settings

January 2017

About HIFA

HIFA (Healthcare Information For All) is a global social movement to improve the availability and use of healthcare information in low- and middle-income countries. It has more than 16,000 members (health workers, librarians, publishers, researchers, policymakers...) committed to the progressive realisation of a world where every person has access to the healthcare information they need to protect their own health and the health of others.
(see http://www.hifa.org/about-hifa/overview)

About mobile HIFA (mHIFA)

The mHIFA Working Group is leading the HIFA community in achieving Mobile Healthcare Information For All, with a focus on information for citizens, parents and children. Recent years have seen an explosion in the use of mobile phones in low and middle income countries (LMICs). This transformation in communication, especially in areas where electricity and infrastructure is scarce, represents a unique opportunity to revolutionise access to health information.
(see http://www.hifa.org/projects/mobile-hifa-mhifa)

About this report

This report has been prepared for HIFA by Dr Geoff Royston, one of mHIFA's expert advisers, with advice and assistance from other members of the mHIFA Working Group. It draws from, and builds on, a previous publication: *Ensuring that mHealth applications provide essential healthcare information for citizens in low resource settings* (2015).

1. Introduction

During 2014, following a survey for HIFA by Kartzinel and Hagar (ref [1]) further work was carried out to develop and operationalise criteria to assess mHealth applications (mobile "apps") for their potential to put relevant, reliable healthcare information into the hands of citizens (including healthcare workers) in low resource settings, to be used as and when they needed. This work produced an assessment tool that used simple "traffic light" indicators showing the stronger and weaker points, from a HIFA perspective, of any mHealth information application. From that work it was possible not only to assess applications but also to draw some conclusions about what appeared most needed in introducing new applications or to improve existing ones.

The criteria, the "traffic light" tool, its use to assess applications (mostly drawn from the above-mentioned survey), and the conclusions about developmental priorities were all set out in the paper *"Ensuring that mHealth applications provide essential healthcare information for citizens in low resource settings"* first published on the HIFA website towards the end of 2014 and still available (in its slightly revised 2015 version) at (ref [2]) .

At about the same time the mHIFA Working Group published a paper in *Lancet Global Health* (ref [3]) outlining the opportunities to transform global health by using mobile phones to empower citizens in low-resource settings with essential, actionable, information on basic healthcare. It challenged content providers, mobile phone manufacturers, network operators, application developers, and international health organisations to collaborate to bring this about.

Since then there have been some encouraging (and some not so encouraging) developments on this front, particularly with some of the mobile apps assessed two years ago, and with the emergence of new apps. There has also been some growth with work that looks further "downstream" - to the actual use of mobile apps focused on providing essential healthcare information in low-resource settings, and (to a very limited extent) on their impact on knowledge, behaviour and healthcare. This update concentrates on the original area of "upstream" assessment of apps, but its penultimate section contains some brief observations about the emerging position on "downstream" issues.

The issue of assessing mHealth applications remains of high-level interest in the global health arena. An important recent (2016) report by John Hopkins University for the Global mHealth initiative *"Mobile technology in Support of Frontline Health Workers" (ref [4])* covers over 140 mHealth projects from developing countries and provides a valuable overview, although the projects ranged much more broadly than provision of health care information to health workers and citizens (e.g. the largest group of projects concerned the use of mobile phones for data collection). Another recent (May 2016) report, from the WHO secretariat, *" mHealth: use of mobile wireless technologies for public health"* (ref [5]), highlighted, as a key obstacle to greater adoption of mHealth , the *"Absence of standards and tools for the comparative assessment of functionality, scalability and comparative value of mHealth solutions, resulting in a lack of evidence to articulate normative guidance".*

It seems timely then to update and extend the original 2014 assessment. This new report stands by itself, although it does not replicate all the background and references contained in the original 2014 paper. This new edition:

- **reviews the criteria and "traffic light" indicators** selected for the 2014 assessment
- **updates the 2014 assessments of particular healthcare information apps** in the light of developments since then
- **includes assessments of some additional apps** particularly some that have appeared since 2014
- **outlines the emerging picture on "downstream" issues** of user engagement with and impact of applications

2. Criteria and "traffic light" indicators

The 2014 paper noted that 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). Taking that wider picture into account is important, but for the 2014 assessment it was felt that the initial requirement was to focus on some more proximate factors related to the comprehension, acceptance and use of information, including not only technological but also cognitive and behavioural factors.

Various frameworks and criteria for assessing mHealth apps have been proposed see e.g. (refs [6, 7, 8]) . These are helpful but typically focus neither on *low resource settings* nor exclusively on mHealth *information* applications. Important exceptions are the useful evaluation guide (ref [9]) produced by the Mobile Alliance for Maternal Action (MAMA) and the short, incisive, paper (ref [10]) by Tomlinson on improving the evidence base for mHealth.

The 2014 paper developed an initial set of criteria and their main components, with a focus 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*, as set out in the box below:

Criteria for assessing mobile apps for relevance to HIFA aims

- **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?

To operationalise these criteria for assessment purposes a simple "traffic light" indicator system was used, as shown in the figure 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 are coded red, amber, or green, with **red** indicating poor alignment to HIFA aims, **green** a good fit and **amber** an intermediate match.

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

So far, the above criteria and indicators appear to have stood up quite well. There are, however, some issues about them which are becoming increasingly important, notably:

Criteria and their components:
Clearly, there is scope to add to or amend the criteria, for example, some people might prefer to take financial cost as a separate dimension. There are of course also wider, more generic, criteria (such as ability to integrate with other health information systems, capacity for scaling-up , and data security) , as for example helpfully identified in the general set of 16 broad criteria for use in assessing any mHealth intervention published earlier this year by the WHO mHealth Technical Evidence Review Group, see (ref [11]). However, for this update we continue to focus on those criteria particularly relevant to HIFA aims.

Attributes and their traffic light indicators:
The 2014 assessment noted that the six apps assessed differed in focus: some, such as HealthPhone, Hesperian Safe Pregnancy and Birth and OppiaMobile appeared to be mainly focused on **healthcare workers**, while others, such as Red Cross First Aid and Mobilium SmartHealth, appeared to be mainly aimed at **direct use by citizens** on their own. These groups will have some different characteristics (for example, healthcare workers are more likely to have higher levels of literacy, and to have more advanced phones – the recent John Hopkins overview mentioned earlier found that nearly 60% of the phones used by community health workers CHWs were smartphones, while use of feature phones was only 14% - and so may have somewhat different capabilities and needs, in terms of both technology and content, in using mobile phones in providing health care information. We have considered therefore differentiating these users in the assessment, which would affect particularly the indicators for *information format, user interface, and mobile platform.* However, this would considerably complicate the assessments. Further, in practice use is often mixed, with healthcare workers using apps together with the public in consultations with their patients or in community meetings. Our original approach, which considers the range of groups covered (especially priority groups like mothers and children) more than whether they typically involve direct use by citizens or use mediated by health workers – still seems a reasonable compromise.

The cost reduction and rapid spread of smartphones and the dropping-off in popularity of feature phones in mid- and low-income countries continues apace (see illustrations below).

Many emerging countries see steep increase in smartphone ownership

Adults who report owning a smartphone

	2013 %	2014 %	2015 %	13-15 Change
Turkey	17	-	59	+42
Malaysia	31	47	65	+34
Chile	39	58	65	+26
Brazil	15	24	41	+26
Russia	23	33	45	+22
China	37	55	58	+21
Poland	21	29	41	+20
Argentina	34	34	48	+14
Venezuela	31	39	45	+14
Mexico	21	28	35	+14
Jordan	38	41	51	+13
Indonesia	11	15	21	+10
Nigeria	19	27	28	+9
Pakistan	3	4	11	+8
Lebanon	45	48	52	+7
Kenya	19	15	26	+7
Ghana	15	14	21	+6
Senegal	13	15	19	+6

Note: Percentages based on total sample. Only countries with statistically significant changes that were surveyed in 2013 and 2015 shown.

Source: Spring 2015 Global Attitudes survey. Q71 & Q72.

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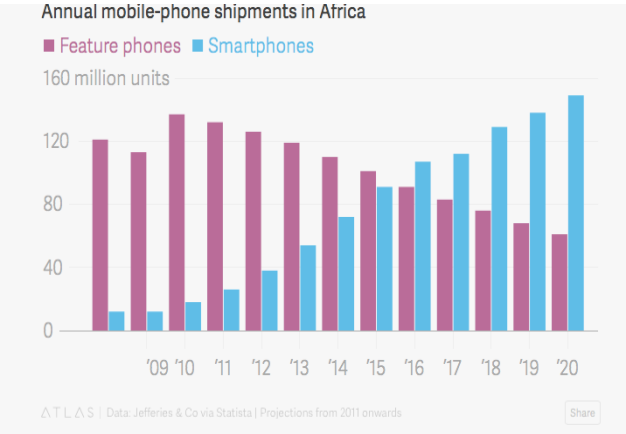
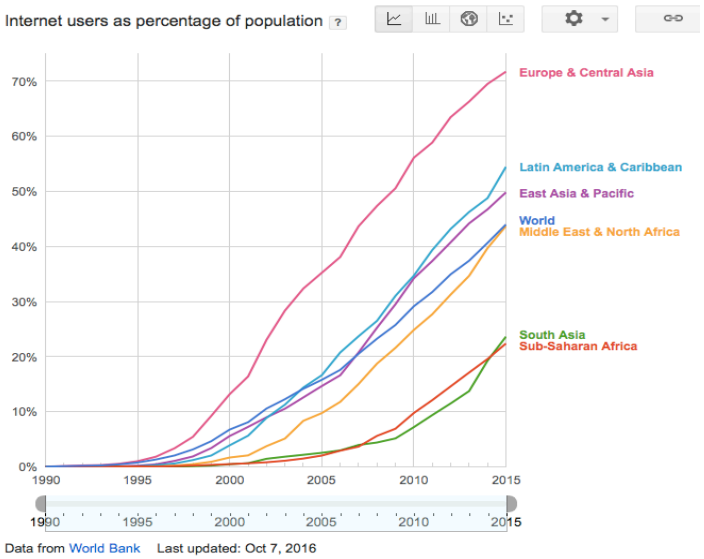


Similarly, the rapid global spread of internet connectivity and users - in many countries mainly using mobile phones - continues (see figure below) Most mid income regions have now attained European usage levels of just 8 years back, and even the low income regions like sub-Saharan Africa are only about 13 years behind.



These technical developments raise the question of whether it would now be appropriate to relax the indicator rating for requiring a smartphone or for requiring internet connectivity from an “orange” to a “green” traffic light. However, the mHIFA Working Group feel that this point has not yet been reached, there are still many places where these requirements would remain obstacles, although the situation is clearly changing quite rapidly and should be kept under review.

3. Developments of application features

The 2014 assessment looked at six mHealth applications (mostly identified in the survey for HIFA) appearing most likely to be most relevant to the needs of users in low resource settings for healthcare information. These applications were: HealthPhone; Newborn Care Series; Safe Pregnancy and Birth; OppiaMobile; First Aid (Red Cross); and SmartHealth. (These were all apps where users can "pull" in Information as and when needed; apps that "push" information out from providers, of a type and at a time of their choosing, notably apps focused on text messaging, were not covered, being outside the main mHIFA focus.) 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 Global Health Media, a primary producer of heath care information videos for frontline health workers in low-resource settings, is a suite of videos on low-cost, low-tech life saving interventions for newborns, 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 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. Information about the UK version can be found at 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

Key developments of these apps features have been as follows

HealthPhone

As well as expanding its content, so it now contains over 2,500 videos in about 80 languages, this curated video library has now been distributed more widely (see penultimate section of this paper). HealthPhone is also now producing some "true mobile apps" - 3 free offline apps on maternal and child nutrition are currently under development and will be released in 2017 in India. All media (videos and images) is included within the app and no additional

download is required. Each app will be in 18 Indian languages. As these apps are still under development they have not been included in this update, but will be considered for any future edition.

First Aid
From originally being available only in English, this app is now available in over 35 languages. Over 80 national Red Cross/Red Crescent societies have now produced a tailored version for their own country. (The International Red Cross/Red Crescent supply an app development toolkit including a platform app – the "Universal App" - to enable the national societies to do this tailoring.) There has also been some evaluation of its *implementation* (see penultimate section of this paper).

Newborn Care Series/Global Health Media Project
The Newborn Care Series comprised videos available on, and freely downloadable from, the Global Health Media website - not an app as such). The GHM project has continued to expand its number and range of videos (now exceeding 60, in up to eight languages) which cover newborn care, childbirth, breastfeeding – but now also some acute conditions (cholera and Ebola). Given this expansion, we have now assessed the whole website and re-labelled accordingly as "Global Health Media Project".

Safe Pregnancy and Birth
This app does not appear to have been developed further since 2014 (or indeed since its original production in 2012). It remains the only part of Hesperian's extensive and highly regarded set of guidance on health care in low-resource settings that is available as a mobile app.

OppiaMobile
There have been a number of other training programmes for health workers in med/low resource settings developed for this platform app; downloadable apps include:

- Bright Future (Pakistan) - https://play.google.com/store/apps/details?id=org.bright.future.oppia.mobile.learning&hl=en (note that this app is being updated)
- Gyan Jyoti (India) - https://play.google.com/store/apps/details?id=org.ujjwal.saathi.oppia.mobile.learning&hl=en
- NURHI (Nigeria) - https://play.google.com/store/apps/details?id=org.nurhi.oppia&hl=en

As they all have a very similar look and feel they have not been assessed individually, but the overall assessment for the OppiaMobile platform has been updated to reflect the developments.

SmartHealth
There has been some development of SmartHealth, for example, a French language version became available shortly after our initial assessment and there is now a Swahili version. However, it is understood that there are no plans to produce an off-line version, or for it to produce more action-oriented guidance for citizens on care of a range of common conditions.

4. Some new "apps"

Of course, since the work on the 2014 assessment, other mobile apps have surfaced or been introduced. A comprehensive survey has not been attempted, but a few of the more relevant "apps" are noted below:

ORB (see **http://health-orb.org**)
This, introduced in June 2015 by mPowering Frontline Health workers, is like HealthPhone in being a website for a curated video-library rather than a standard mobile app. It comprises an extensive set (some 400 items) of quality-assured and mobile-optimised multimedia training materials (from several content providers such as GHM and MAF) for frontline health workers. It is focused on maternal and child heath, covering family planning, antenatal natal and newborn care, child health, and nutrition (and, shortly, Zika). All materials can be freely downloaded under a Creative Commons license (though seemingly not an open version of the CC license, so not allowing translation or adaptation) to a mobile or tablet, after which internet access is no longer required. Much of the material has versions in a range of languages.

One recent development is the partnership of ORB with the Global Health Media Project: GHMP provides videos for ORB, while ORB helps distributes them and helps health workers use them more effectively, with their videos being incorporated into new training programs being introduced in several African countries.

The **Zero Mothers Die App** (see www.zeromothersdie.org), one of the newer (June 2016) apps, is produced by the global partnership initiative of the same name. It has separate sections for frontline health workers and for new mothers and mothers- to-be. The former are a subset of the videos, courses etc. available through ORB. The latter sections contain extensive information (though entirely in text) about stages of pregnancy and the first year of life. English and French versions are available.

Safe Delivery (see http://maternity.dk/the-safe-dilevery-app NB this spelling is "correct")
This app, from the Maternity Foundation, supports skilled birth attendants' capability and confidence in providing respectful, evidence-based basic emergency obstetric care. The content of the app is based on global clinical guidelines and has been validated with an international group of global health experts. It contains four basic features: 10 animated instruction videos, action cards, drug list and practical procedure instructions. All features and functions are designed for low-literacy, low-income settings and work completely offline once downloaded. A field evaluation of the impact of this app has been published (see later).

Medical Aid Films (MAF) is another primary producer of health care information videos for community health education or for training health workers in low-resource settings. Like GHMP, MAF has a website (www.medicalaidfilms.org) from which about two hundred such videos (covering nutrition, maternal health, newborn and child health, sexual and reproductive health, emergency obstetrics and neonatal care and Ebola) in up to 20 languages can be freely downloaded, in a mobile-friendly format. As some of its videos are

in HealthPhone it was obliquely covered in the 2014 assessment but it was not assessed separately. Given its similar scope to GHMP there seem a good argument for including it in its own right.

A similar argument applies to **SAWBO,** (Scientific Animations without Borders) which maintains a mobile friendly video library (http://sawbo-animations.org/home/), especially as it now has an associated Android and iOS mobile app (**SAWBO deployer**) to assist downloading of the videos to a mobile phone (NB one of the deployer browsing filters (topic) needs attention – currently its use can cause a crash; the other two filters (language and country) operate well).

More generally, in a follow–up to the original survey of mHealth information apps, a HIFA–commissioned survey (again conducted by San Jose University) to determine what video information was available for citizens in low and middle income countries through mobile devices, identified additional such providers/libraries such those of **Alive And Thrive** (http://aliveandthrive.org/types/videos) and **iHeed** (www.iheed. org also www.iheedcrowd.org) (NB it is not clear what the current status of iHeed is in regard to video production or curating, and their production partner Mobento appears to be no longer operating). Other relevant video developer sites include **Chocolate Moose Media** (www.chocmoose.com)

Mobile Kunji (and a sister app **Mobile Academy**) is from the BBC Media Action project (see http://downloads.bbc.co.uk/mediaaction/policybriefing/bbc_media_action_health_on_the_move.pdf) . Mobile Kunji is very different from all the rest of the apps considered here (and is not being included in the traffic light assessment) but has some unique features that merit its inclusion in this paper. It involves healthcare workers, when counselling rural families, using basic mobile phones to ring a series of toll-free numbers (identified from picture cards relating to a variety of essential health topics) to access an interactive voice recording giving healthcare information to them and the families on 40 different topics covering essential information on pregnancy and newborn health. The messages are delivered in the voice of a woman doctor character, designed to be both engaging and conversational and to reinforce the health message illustrated on the card. Mobile Academy is similar but proves a longer programme of training course material for healthcare workers.

There are of course other new apps that could be considered, such as the **WHO Zika** app (see http://www.who.int/risk-communication/zika-virus/app/en/) or the **MeToo** app. (see http://apk-dl.com/metoo/com.uriosweb.appidays.metoo) However the former is an example of a specific "niche" app for health care workers, and the latter leans heavily towards being a *diagnostic* app (using the cameraphone). Such apps, innovative and important though they may be, seem outside the scope of an assessment focusing on mHIFA goals for citizen access to essential healthcare information. (Similarly, we do not consider the raft of available mHealth apps that are aimed at supporting tasks such as health care administration or management).

5. The updated "traffic light" assessments

We have extended the traffic light assessments to also cover five of these new "apps", almost doubling the number of "apps" covered in our assessment.

Note that, as well as varying in their *focus* (on health workers, on citizens or on both, as outlined above) these "apps" fall into three *forms*:

- **true mobile apps** - apps that can be downloaded, usually from an app store like Google Play. (These could in turn, though for simplicity we have not done so, be sub-divided into those being or having a "platform" app to assist production of versions tailored to different topics, target groups or countries (OppiaMobile, First Aid), and those that are "standard" single version apps (Safe Pregnancy and Birth, Safe Delivery, Zero Mothers Die, SmartHealth))
- **websites of curated libraries of downloadable resources (particularly videos) from various sources (**HealthPhone, ORB)
- **websites of primary content (videos) producers** (Medical Aid Films, Global Health Media Project, Scientific Animations without Borders)

We have used the above groupings in the following assessments. Each group has a corresponding traffic light assessment as below. The true mobile apps are in covered in two sections, the first comprising fairly broadly focused apps and the second being on apps focusing specifically on maternity and newborn care, the third and fourth sections respectively cover websites of curated libraries and websites of primary content producers. At the end of the set of four traffic light tables there is a single page of "radar plots" summarising the results (the better the assessment scores are, the more completely shaded are the circular plots).

Note, as in the 2014 paper, that the assessments are from the particular (mHIFA) perspective of how far the apps have potential to put essential healthcare information into the hands of healthcare workers and citizens in low resource settings, to be used as and when needed, and do not imply any more general view of their merits or otherwise.

MOBILE APPS

CRITERION	COMPONENTS	OppiaMobile (Digital Campus)	Rating 2016	Red Cross/Crescent First Aid	Rating-2016	SmartHealth (Mobilium)	Rating 2016
SIGNIFICANCE OF THE HEALTH PROBLEM(S)	URGENCY	Covers many aspects of communicable and non-communcable 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	1
	SEVERITY	Broad and deep coverage of many health problems	2	Focused on a range of moderate and serious problems	2	Focused on major conditions but limited to just three of these (HIV, tuberculosis, malaria)	1
APPROPRIATENESS OF THE TARGETING	TARGET AUDIENCE	Health workers only - all material is in form of training courses	1	General public, and there is a companion app focused on babies and chidren (for UK version)	2	General Public? Nothing focussed on mother and child	1
	COUNTRY(IES) OF USE	Low and middle income	2	Now avaialble in over 80 countries, including many low and middle income ones	2	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	1
	RELEVANCE TO USERS' NEEDS	Essential information	2	Essential information	2	Information rather general; the symptom checker ("isabel") only signposts to elsewhere	0
	EASE OF RELATING TO ACTION	Strong linkage to action	2	Strong linkage to action	2	Material very variable in pointing to action	1
EASE OF ASSIMILATION OF THE INFORMATION	INFORMATION FORMAT	Largely text, but with text to speech conversion facility. Some diagrams. Quizzes. A few videos.	2	Short videos for most items	2	App is text-heavy; there are links to a few YouTube videos	1
	LANGUAGE(S)	Mainly English, some courses in in Hindi and Urdu	1	Now available in over 35 languages	2	English, French, Portuguese, Swahili	1
AVAILABILITY OF THE APPLICATION	GEOGRAPHICAL PROVISION	Generic, plus specifc applications for Ethiopia, Pakistan, India, Nigeria	2	Tailored versions now available for over 80 countries	2	Pan-African	2
	COST TO USER	App is free, (except possible data charge for one-off download?)	2	App is free, (except possible data charge for one-off download?)	2	App is free (but may be data charges for online use)	1
TECHNOLOGICAL ACCESSIBILITY OF THE APPLICATION	USER INTERFACE	Tailored moblie app, easy to navigate	2	Tailored mobile app, 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	0
	MOBILE PLATFORM	Smartphone or tablet	1	Smartphone required	1	Smartphone or tablet	1
	OPERATING SYSTEM	Android	2	Android, iOS	2	Android	2
	ADDITIONAL PHYSICAL MEDIA NEEDS	None (material downloadable but not preloaded)	1	None (material downloadable but not preloaded)	1	Preloaded on Samsung phones and tablets in Africa, downloadable elsewhere	2

MOBILE APPS (CTD)

CRITERION	COMPONENTS	Zero Mothers Die (Zero Mothers Die Partnership))	Rating 2016	Safe Delivery (Maternity Foundation/Copenhagen University)	Rating 2016	Safe Pregnancy and Birth (Hesperian)	Rating 2016
SIGNIFICANCE OF THE HEALTH PROBLEM(S)	URGENCY	Full range of urgency covered	2	Full range of urgency covered	2	Includes emergencies	2
	SEVERITY	Moderate/emergency problems in pregnancy and childcare , (by definition, no other areas covered)	1	Moderate/emergency problems in pregnancy and neonatal care, (by definition, no other areas covered)	1	Moderate/emergency problems in pregnancy and childcare , (by definition, no other areas covered)	1
APPROPRIATENESS OF THE TARGETING	TARGET AUDIENCE	Pregnant women, new mothers and health workers caring for these groups.	2	"Skilled birth attendants"	1	Health workers involved in maternity care	1
	COUNTRY(IES) OF USE	Low and middle income	2	Information oriented to low income countries	2	Information oriented to low income countries	2
VALUE OF THE INFORMATION	RELIABILITY	Well accredited sources	2	"Validated by international experts and doctors within obstetrics and pediatrics "	2	Authoritative	2
	RELEVANCE TO USERS' NEEDS	Essential information. Contains instructional videos and online courses.	2	Covers key health issues and concerns of user group	2	Covers key health issues and concerns of user group	2
	EASE OF RELATING TO ACTION	Strong linkage to action	2	Strongly action-oriented, with details on key procedures and information on drugs	2	Strongly action -oriented	2
EASE OF ASSIMILATION OF THE INFORMATION	INFORMATION FORMAT	Information for patients is text-only though healthworker information has a good set of videos (a subset of the curated video library on ORB) .	1	Many instructional videos, plus quick reference action cards	2	App is text-heavy but has simple illustrative diagrams	1
	LANGUAGE(S)	English and French	1	English only	0	English and Spanish	1
AVAILABILITY OF THE APPLICATION	GEOGRAPHICAL PROVISION	Non-specific	1	Non-specific	1	Non-specific	1
	COST TO USER	App is free (except possible data charge for initial download)	2	App is free (except possible data charge for initial download)	2	App is free (except possible data charge for initial download)	2
TECHNOLOGICAL ACCESSIBILITY OF THE APPLICATION	USER INTERFACE	Mobile app, easy to navigate the menu	2	Moble app, menu extremely easy to navigate	2	Moble app, menu very easy to navigate	2
	COMMUNICATION REQUIREMENTS	Many of the videos and training courses require an internet connection, others require additional apps such as Vimeo to download or run	0	All videos and other material work offline	2	Works offline	2
	MOBILE PLATFORM	Smartphone or tablet	1	Smartphone or tablet	1	Smartphone or tablet	1
	OPERATING SYSTEM	Android	2	Android	2	Android or iOS	2
	ADDITIONAL PHYSICAL MEDIA NEEDS	None- but see communicaton requirments	1	None - app downloadable though not preloaded	1	None - app downloadable though not preloaded	1

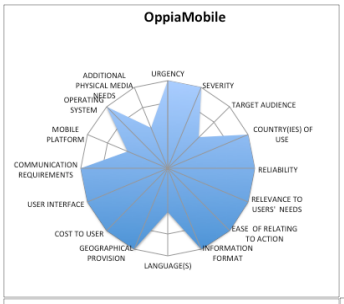
CURATED COLLECTIONS

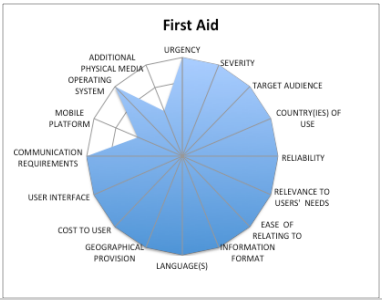
CRITERION	COMPONENTS	HealthPhone (Mother and Child Health Education Trust)	Rating 2016	ORB (mPowering Frontline Health Workers)	Rating 2016
SIGNIFICANCE OF THE HEALTH PROBLEM(S)	URGENCY	Covers many aspects of chronic and acute care, including maternity and child health	2	Covers many aspects of chronic and acute care, especially on maternity and child health	2
	SEVERITY	Broad and deep coverage of many health problems	2	Broad and deep coverage of many health problems	2
APPROPRIATENESS OF THE TARGETING	TARGET AUDIENCE	Health workers and prority groups - ' provides families with their own personal reference library and guide to better health practices'.	2	Focus is on training frontline health workers, only a little material identified as for citizen use	1
	COUNTRY(IES) OF USE	Focus on low income countries	2	Focus on low income countries	2
VALUE OF THE INFORMATION	RELIABILITY	Approved by various officlai bodies; draws on UN Facts for Life publication.	2	All material has to go through an expert content review team	2
	RELEVANCE TO USERS' NEEDS	Focus is on essential information needs especially for prevention.	2	Focus is on essential information needs .	2
	EASE OF RELATING TO ACTION	Most material is strongly action related	2	Most material is strongly action related	2
EASE OF ASSIMILATION OF THE INFORMATION	INFORMATION FORMAT	Very large curated video library (hundreds of videos) drawn from multiple primary sources	2	Very large curated libray of videos (nearly 200), slides, documents and other resources drawn from multiple primary sources	2
	LANGUAGE(S)	Multi lingual (around 80 languages in total, including 15 Indian languages)	2	Multi lingual (about 25 languages in total)	2
AVAILABILITY OF THE APPLICATION	GEOGRAPHICAL PROVISION	India and other countries	2	Many regions and about 20 specific countries covered	2
	COST TO USER	Free, (except possible data charge for one-off download?)	2	Free, (except possible data charge for one-off download?)	2
TECHNOLOGICAL ACCESSIBILITY OF THE APPLICATION	USER INTERFACE	Not an "app" as such, website has an item selection menu, navigation may be difficult for some	1	Not an "app" as such, but website has a fairly easily searchable item selection menu , though navigation may be difficult for some	1
	COMMUNICATION REQUIREMENTS	Material available on-line and (via micro SD card) off-line	2	Requires internet access to view or download any item.	1
	MOBILE PLATFORM	Wide range of device types. Some text for basic phones, feature phone suffice for other materials.	2	Smartphones or tablets needed for most material, feature phones OK for some .	1
	OPERATING SYSTEM	Multiple	2	Multiple	2
	ADDITIONAL PHYSICAL MEDIA NEEDS	All material can be downloaded, and while it is not preloaded it is also available on microSD	1	None - material can be downloaded, although it is not preloaded. Viewing some videos requires downloading additional apps (Vimeo)	1

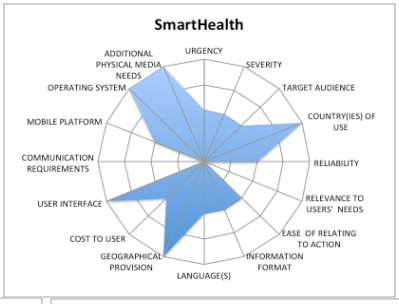
CONTENT PROVIDERS

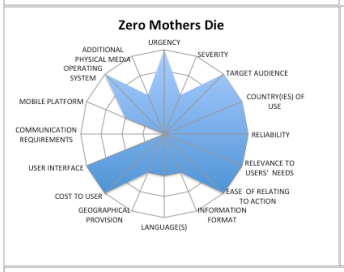
CRITERION	COMPONENTS	Medical Aid Films	Rating 2016	Global Health Media Project	Rating 2016	Scientifc Animations Without Borders	Rating 2016
SIGNIFICANCE OF THE HEALTH PROBLEM(S)	URGENCY	Covers many aspects of chronic and acute care	2	Full range of urgency covered	2	Covers aspects of chronic and acute care (though not maternity or newborn)	1
	SEVERITY	Broad and deep coverage of many health problems	2	Mostly on moderate/emergency problems in pregnancy and childcare , but also some material on cholera and ebola	1	Focus on a few selected acute conditions (e.g. Chagas, ebola, cholera, dengue) and prevention (eg handwashing, TB, malaria)	1
APPROPRIATENESS OF THE TARGETING	TARGET AUDIENCE	"Skilled health workers and community education groups".	2	Particularly for health care workers caring for pregnant women and mothers of young children ,but also wider community education	2	Health workers and prority groups.	2
	COUNTRY(IES) OF USE	Focus on low income countries	2	Low income	2	Focus on low income countries	2
VALUE OF THE INFORMATION	RELIABILITY	Clinical experts fully involved in production	2	Well accredited sources	2	Expert validation process	2
	RELEVANCE TO USERS' NEEDS	Essential information.	2	Essential information.	2	Focus is on essential information needs	2
	EASE OF RELATING TO ACTION	Most videos strongly action related	2	Strong linkage to action	2	Most videos strongly action related	2
EASE OF ASSIMILATION OF THE INFORMATION	INFORMATION FORMAT	All (by definition!) material in video form -- extensive library of (about 200) videos	2	Large video library (now over 60 videos)	2	Library of videos (not only on health, but about 30 are on health topics)	2
	LANGUAGE(S)	Multi lingual- about 20 languages in total	2	Mulitilingual - about 10 languages in total - including English, Spanish, French, Swahili, Nepali , and Khmer	2	Multi lingual (over 30 languages in total)	2
AVAILABILITY OF THE APPLICATION	GEOGRAPHICAL PROVISION	Some of the videos are country specific (MAF has partnerships in 19 countries)	2	Supernational	2	Over 50 countries covered	2
	COST TO USER	Free, (except possible data charge for one-off download?)	2	Free (except possible data charge for initial download)	2	Free, (except possible data charge for downloads)	2
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	1	Not an "app" as such",website has large menu of video downloads, menu navigation may be difficult for some .	1	SAWBO website has large menu of video downloads, the SAWBO deployer app allows easy search & access (NB the rating assumes a minor search bug will be fixed!)	2
	COMMUNICATION REQUIREMENTS	Internet access required to download each item	1	Internet access required to download each item	1	Internet access required to download each item; though deployer app allows video sharing via Bluetooth	1
	MOBILE PLATFORM	Smart phone, tablet or feature phone	1	Smartphone, tablet or feature phone	1	Smartphone, tablet or feature phone	1
	OPERATING SYSTEM	Multiple	2	Any? However, Android phones may require downloading an app (such as VLC for Android) to play the videos which are in mov. (Quicktime) format	1	Any (though SAWBO deployer app not compatible with iOS)	2
	ADDITIONAL PHYSICAL MEDIA NEEDS	None - all videos can be downloaded	1	None- all videos downloadable .	1	None - all videos can be downloaded	1

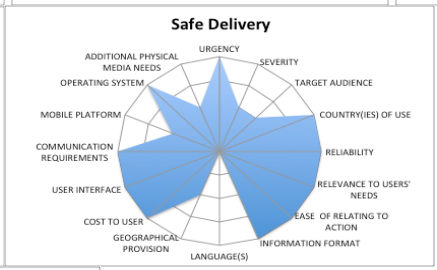
Radar plot summaries of the assessments

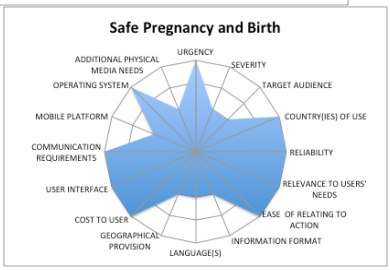


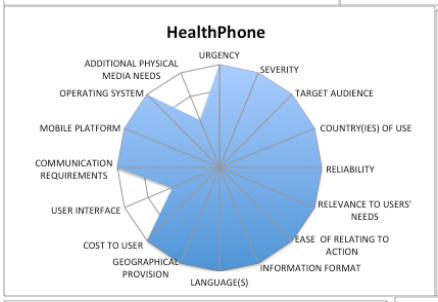


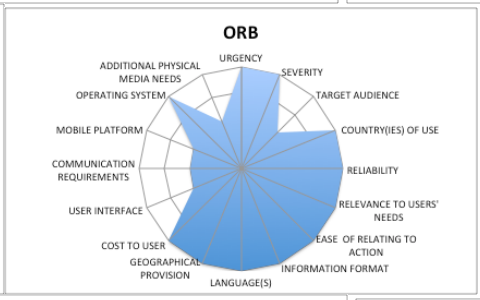


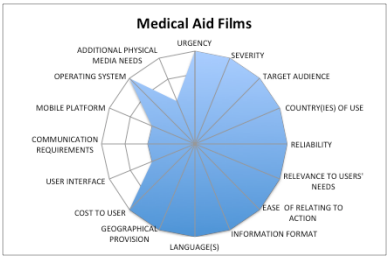


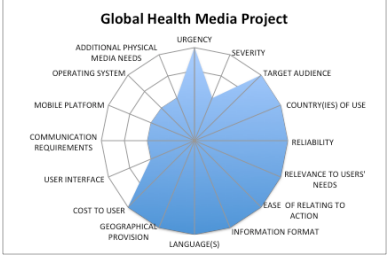


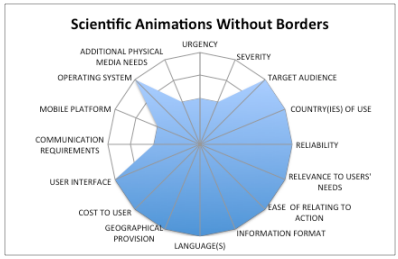












Some comments on the assessments

- the **true mobile apps** . The development of the Red Cross First Aid app has improved its rating and it has now become one of the two top scoring apps. OppiaMobile also continues to rate very well. Smart Health continues to lag well behind due to lack of actionable information and need for online access for much of its content. All three of the assessed apps (Safe Pregnancy and Birth, Safe Delivery, Zero Mothers Die) that are focused exclusively on maternity and child care score quite well, and the assessments show how they could quite easily be further improved by, for example, increasing the number of languages they support.
- **the websites of curated libraries (**HealthPhone, ORB) **of downloadable resources (particularly videos) from various sources** score highly, with HealthPhone having the edge and indeed, across all the assessed tools, sharing top place (with the Red Cross First Aid app). However, both lose marks from not being "true mobile apps" providing a user friendly interface to their libraries. ORB's involvement with the Zero Mother's Die app, and HealthPhone's current work on developing some "true" apps to be released shortly , suggests they could both readily produce such an interface; these would be valuable enhancements.
- **websites of primary content (videos) producers** (Medical Aid Films, Global Health Media Project, Scientific Animations without Borders). Perhaps surprisingly, given these are single provider websites, rather than true apps or curated multi-source libraries, these all scored very well. One of them (SAWBO) has produced a companion app that provides a user-friendly interface for the library, a development that, as noted above, others might usefully consider.

6. Evaluating the actual use and impact of the apps

The above (and the earlier 2014) assessment is of the ***potential*** of apps to deliver relevant, reliable healthcare information into the hands of citizens, to be used as and when needed. It did not extend into looking at the ***actual*** take-up, use and impact of such apps, partly because that would require associated field investigations, or at least reports from field investigations, of which at that time there appeared to have been very few.

Remarkably, this limitation proved less of a drawback than expected, *as a great deal of insight into the likely value of healthcare information apps proved to be obtainable from the examination of their internal characteristics.* (Indeed one benefit of such examination is that it should avoid wasted effort on field investigation of applications whose assessment of potential already shows them likely to be of very limited value). However, "downstream" assessment of actual use and impact is clearly important, not least to further test and refine the more promising applications. Information on this, while still very patchy (and not yet sufficient to merit extending our "traffic light" tool), is now beginning to become available, as shown briefly below.

The take up and usage of mHealth information apps that are covered in our assessments

Google Analytics shows downloads ranging from 100K or more (Hesperian Safe Pregnancy, Red Cross First Aid app in several mid-income countries) to a few hundred (SmartHealth in

any country; Red Cross First Aid in most low-income countries covered). However, these figures are of limited use, as they exclude pre-loading and peer-to-peer transfers of apps, so for example the actual number of phones which have had SmartHealth loaded must be not hundreds but *millions* as it is reported as being pre-loaded on all Samsung smartphones sold in Africa – running at tens of millions a year! More useful information is however available for some of the apps covered, as shown below.

HealthPhone has now been disseminated widely to be available to millions of people:

- in Maharashtra, India (pop 118m) the government, with support from UNICEF, is providing every health worker (180,000) with a microSD card containing the HealthPhone video library.
- the IAP HealthPhone programme, launched in June 2015, is a digital mass education programme to tackle the challenge of malnutrition in women and children at the national-level in India. It is a public/private partnership between The Indian Academy of Pediatrics (IAP), HealthPhone, MWCD, UNICEF and Vodafone. Four videos, jointly produced by MWCD and UNICEF in 18 Indian languages, are downloadable and viewable, free of data charges, to approximately 200 million Vodafone customers in India. The videos address issues of status of women, the care of pregnant women and children under two, breastfeeding and the importance of balanced diet, health and simple changes in nutritional care practices

The **Red Cross First Aid App,** which is now available in country-specific versions to hundreds of millions of people in over 80 countries, has had some detailed investigation on take-up and usage. An evaluation of its implementation in eight (five high- and three mid- income) countries was carried out in 2015. The very helpful report on this evaluation is available on a Red Cross website (ref [12]) and there is also a published academic paper (ref [13]). The percentage of the study country populations who had downloaded the app ranged from 0.01% (5,000 people in Myanmar) to 4% (13,000 people in Iceland), though this, especially the lower figure, will be an underestimate as the figures are from Google analytics (see above). Higher take-up appeared to be associated with internet and smartphone penetration, media exposure, and population density. Typical usage of the app was in sessions averaging two to three minutes. The most common topic accessed was burns. Over 85% of users (self-selected) who offered feedback gave positive comments.

Mobile Academy and a "sister" to Mobile Kunji, **Mobile Kilkari** (a "push" app for expectant and new mothers , so outside the scope of this paper's assessments) are now being rolled out nationally by the Indian Ministry of Health and Family Welfare, with funding from the Indian government, the Gates Foundation, USAID and the Barr Foundation. This is a very large mobile health programme – it aims to train one million community health workers and help nearly 10 million new and expecting mothers. (Kilkari is now making calls to 850,000 families in six states, and will scale to reach 9.5 million new and expecting mothers a year.)

For Mobile Kunji , Reba Rani, a community health worker in Bihar noted: *"Now that I have Mobile Kunji, every time a woman asks me for information, I look at the index card of the Mobile Kunji deck of cards and choose an appropriate message. All I have to do is explain the information on the card and dial the number "*

Mobile Academy is now accessible to 150,000 health workers across four states, and will scale to reach nearly a million health workers. So far, 21,500 have called the service (despite it not being free). Twenty two per cent of users have already completed the course. Just over 4,700 health workers are eligible for certificates for passing the course and trainees have accessed more than 1.7 million minutes of training content.

Impact evaluation of the mHealth information apps covered in our assessments

So far, there has been very limited field-based evaluation of impact on knowledge, behaviour or health for the apps covered in our assessments. Important exceptions include:

HealthPhone. Although so far largely anecdotal there are reports (ref [14]) of associated improvements in increased use of ORS and Zinc during diarrhoea episodes, and of increased frequency of handwashing, breastfeeding and immunization.

ORB. There is a report (ref [15]) on training of 200 healthcare workers in 18 clinics via partnership with the ORB pilot in Ondo State, Nigeria, in May 2016, using a tablet with pre-loaded ORB training material. Although the evidence again appears to be largely anecdotal, it is stated that as a result of watching the ORB training videos, midwives and community health education workers were better able to understand the optimal antenatal care, to schedule patient visits and to build rapport with patients. For example, two midwives reported that an ORB video on delivery of the placenta changed the practice in their clinic. ORB was considered similar to but better than MAMA Connect because it delivered learning more effectively and could be used off-line.
One interesting observation was that *"as ORB was positioned for health workers it had not occurred to most to share it with women in the clinic or the community; however most healthcare staff agree that some of the content would be really useful for new/expecting mothers… because the videos are interesting and easy to understand …though a larger screen would be more effective for group viewing".*

Red Cross First Aid
Although the review noted above focused on implementation and usage rather than impact, the review briefing paper refers to examples where the app had been successfully used to manage a health emergency e.g. a user from Ireland reported *"Had a situation of unconsciousness and not breathing yesterday in my home with my sister. A lot of people panicked, but remembering I had the app handy for a while now, whipped it out and had a quick few second video on exactly what to do, got her breathing under the instructions, lifted her to the car, sat in the back with her and got to A&E, and she was ok to leave by morning."*

Mobile Kunji and Mobile Academy
The BBC briefing paper (see the Media Action website link in Section 4) reports emerging anecdotal evidence on the health impact of these services. For example, one senior supervisor of community health workers in the district of Gopalganj reported a spike in women coming to the health facility.

The team has also seen anecdotal evidence in the field that women are heeding the advice found in Mobile Kunji. One pregnant woman spoke, for example, of how she was convinced by her health worker – and Mobile Kunji – to register for free government health products and services, such as iron folic acid tablets and tetanus toxoid.

Hesperian/Safe Pregnancy and Birth
Hesperian have adopted an outcome mapping approach to measuring the impact of the health information they provide, which should be applicable to their app.

Safe Delivery
This app is noteworthy in having had a *randomised control trial on impact*. The first four films of the app (active management of third stage labour, post-partum haemorrhage, manual removal of retained placenta, and neonatal resuscitation) were tested in a one-year randomized controlled trial in 73 facilities in Ethiopia to assess the impact on 176 health workers life-saving skills and knowledge. Key results revealed a statistically significant increase in the skills and knowledge level of the health workers using app, e.g.: at 12 months health workers ability to handle post-partum haemorrhage (PPH) and to resuscitate a newborn (NR) more than doubled. Use of the safe delivery app was associated with a lower perinatal mortality of 14 per 1000 births in intervention clusters compared with 23 per 1000 births in control clusters, though this did not reach conventional statistical significance levels. See (ref [16])

Medical Aid Films
There have been some studies into the impact of films from MAF (see ref [17]) , showing for example “an average 44% improvement in knowledge and practice after watching our films”.

7. Conclusions

The main conclusions of the 2014 assessment were:

- the more promising applications should be further developed, especially in regard to adding content and languages appropriate for direct use by citizens and in a wider range of countries and cultures, taken up by mobile phone enterprises, and rolled out as far and as fast as possible;
- In the longer term the need was to develop applications, purpose built for use in low resource settings, that *combine* the positive features of applications such as those that had been assessed, this implied developing apps that would *work off-line* and with (particularly) the following features:
    - health content – could prioritise *health education, maternal and reproductive health, child health, and first aid*
    - format of material – should make full use of *pictorial and video-based material* and 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 – need a *simple and intuitive “front end”*, with easy navigation and icons for use in low literacy settings;

    - technical platform – *feature/smartphones or tablets* could probably be assumed available for applications aimed at health workers; applications for direct use by citizens and patients would increasingly be able to do as such devices rapidly became 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.

These conclusions still stand, and, as this update shows, there has been some encouraging progress (for example more *languages,* more *video content* and more material on *first aid* and *health education) but* some considerable way still to go on off-*line access* and *user-friendly interface*s) . In addition to these points this update has highlighted or reinforced a number of key issues both for developing apps and also in regard to improving "downstream" use:

- **app development** – *platform apps* such as OppiaMobile and the Red Cross "Universal App" can make the app development process much easier, and easier to devolve to national or regional bodies to ensure apps are tailored to local needs. (An example of work to systematise development and deployment is mPowering Frontline Health Workers' "Open Deliver" approach, which combines existing, open source technologies into an *integrated process* for "app" design, content modification/production, deployment to mobiles, and usage monitoring. These technologies include: ORB, for sharing mobile training content; Moodle, a system for course creation; and OppiaMobile, for delivery of course content in app form.)

- **app availability** – this clearly remains a problem. Although many of the assessed apps are in principle available to millions, even hundreds of millions, of people through national app stores or otherwise, in practice the actual availability is likely to be much less. In particular, there can be difficulties where there is limited internet access, especially of course for apps that are not fully downloadable and so require more than a one-off online connection. There are various steps that could help, including:

    - Continuing to try to increase availability by voluntary cooperation with mobile phone companies on *pre-loading* apps on phones or SD cards- as already done for the high-rated HealthPhone in India (and the lower-rated SmartHealth in Africa)

    - Using technical innovations such as *"medical internet-in-a box"* (see http://internet-in-a-box.org) to overcome the need for online access. (These boxes have wifi hotspots and will allow citizens up to several hundred metres distant to download stored healthcare information content (such as HealthPhone videos), free of charge, to their mobile phones or other devices. They can run on a battery and therefore can go anywhere.)

    - Seeking to persuade (perhaps on human rights and public health grounds) one or more governments to make installation of an approved app on essential health care information a *legal requirement* for mobile phone companies. (There is some precedent for this sort of action - in the Netherlands, where, when introducing its

NL-Alert disaster warning service, the Dutch government required mobile phone manufacturers to pre-configure all new cellular phones so that they could automatically receive cell broadcasts issued by this service.)

Another availability problem that has been reported is in distinguishing an app from an accredited source from other available apps, some of which can look deceptively similar (this has for example been a problem with the Red Cross app). At its worst, this is the mHealth equivalent of counterfeit branded pharmaceuticals. This might be mitigated if there was one place an LMIC user could go to download some reputable health care information apps, such as a collective site that described, rated (using mHIFA's work) and provided easy access to such apps (ref [18] *)*

- **app take up and use** - the penetration and utilisation of apps providing essential healthcare information, even when they are available, is a tiny fraction of what it could be, especially in lower-income countries, and particularly for "direct to citizen" apps. Some of this obviously is due to the as yet limited availability of smartphones and internet access, though that is quite rapidly becoming less of a barrier. But even when a healthcare information app is readily available, people still may not take it up or use it. This problem could be tackled by:
    - increasing *awareness* though e.g. media publicity, although that can be expensive.
    - increasing *incentives* for take up , for example by seeking and publicising compelling examples of successful use
    - greater use of *intermediation* by health workers i.e. health workers having material suitable for use by citizens on their mobile devices and sharing it with them - and indeed, where appropriate, then transferring the app to their phones. (A further advantage of this approach is that it offers at least some access to such material to people *without* a mobile phone (see eg ref [19]).

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