e-health applications may transform
African healthcare: needs, progress
and future

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Personal background

- 30 years of research, teaching and training in tropical clinical pharmacology mostly as African collaboration

- Combine molecular, clinical and epidemiological and health intervention approaches

- 25 years of research, development and clinical services on Rational Use of Medicines including design, implementation and evaluations of e-pharmaco-logical tools (knowledge and infrastructure) in Sweden, Europe and Africa
Disposition

- Needs
- Progress
- Future
Global health burden
2004 versus 2030

Figure 3.
Technologies for global health-Lancet 2013

Projected changes in rankings of leading causes of disability-adjusted life-years 2004–30

Data taken from WHO. \textsuperscript{98} COPD=chronic obstructive pulmonary disorder. *Includes other non-infectious causes arising in the perinatal period, apart from prematurity, low birthweight, birth trauma, and asphyxia.
Thorough review

Technologies for global health

Peter Howitt, MAa, Prof Ara Darzi, FRCSa, Prof Guang-Zhong Yang, PhDa, Hutan Ashrafian, MRCSk, Prof Rifat Atun, FRCPi, Prof James Barlow, Phdn, Alex Blakemore, Phdi, Prof Anthony MJ Bull, Phdd, Josip Car, Phdm, Lesong Conteh, Phda, Graham S Cooke, Phdf, Nathan Ford, Phdf, Simon AJ Gregson, Phdg, Karen Kerr, Phda, Dominic King, MRCSc, Myutan Kulendran, MRCSc, Prof Robert A Malkin, Phdd, Prof Azeem Majeed, MDj, Prof Stephen Matlin, DSca, Robert Merrifield, Phda, Hugh A Penfold, PhDö, Steven D Reid, Phdf, Prof Peter C Smith, BAc, Prof Molly M Stevens, Phdd, Michael R Templeton, Phde, Prof Charles Vincent, PhDk, Elizabeth Wilson, MScb

Lancet 2012
e-health tools in rural Africa should

- provide easy and rapid access to information, guidelines and knowledge
- help provide patient-centered care
- support continuous learning at work
- empower healthcare staff and patients and their learning
- be affordable, sustainable, transparent open source
Study 1 about needs of guidelines

Masters in public health (n=43)
Will computerised guidelines make your work easier?

Yes                  41
No                      2

Comment on needs: Flow charts and concise summary of rational for the actions.

Heller, Oaya, Gustafsson et al 2013
Study 2: Needs of drug ordering tool

Nilseng J, Gustafsson LL, Nungu A, Bastholm P, Mazali D, Pehrson B, Eriksen J. A cross-sectional pilot study assessing needs and attitudes to implementation of Information and Communication Technology for rational use of medicines among healthcare staff in rural Tanzania. In manuscript 2013

Positive attitudes: gain time using electronic ordering, appreciation of structure, easiness of overview and use of "tablet-application"

Bunda, Tanzania: 2011
Correspondence

“Quality of prenatal and maternal care: bridging the know-do gap” (QUALMAT study): an electronic clinical decision support system for rural Sub-Saharan Africa

Antje Blank1*, Helen Prytherch², Jens Kaltschmidt¹, Andreas Krings¹, Felix Sukums¹, Felix Sukums1,3, Nathan Mensah14, Alphonse Zakane5,6, Svetla Loukanova2, Lars L Gustafsson6, Rainer Sauerborn2 and Walter E Haefeli1
Study 3: Needs and attitudes to decision support for maternal rural care

Guidelines for maternal and neonatal “point of care”: needs of and attitudes towards a computerized clinical decision support system in rural Burkina Faso

S Alphonse Zakane (SAZ)\textsuperscript{1,2}

Lars L Gustafsson (LLG)\textsuperscript{2}

Göran Tomson (GT)\textsuperscript{3,4}

Svetla Loukanova (SL)\textsuperscript{5}

Ali Sié (AS)\textsuperscript{1}

Josefine Nasiell (JN)\textsuperscript{6}

Pia Bastholm-Rahmner (PBR)\textsuperscript{3,7,8}

\textit{Int J of Medical Informatics, in review 2013}
Findings I using qualitative approach study

- Healthcare workers are fascinated about and very willing to adapt modern technologies like computers and learn at workplace

- **Positive** to easily get access to guidelines and implement decision-support using computers at work

- **Fear** that the “A Decision Support” requires more working time and double-work

- Fear a complicated program that requires substantial computer training and extensive instructions
Findings II using qualitative approach

● Healthcare workers are fascinated about and very willing to adapt modern technologies like computers and learn at workplace

● **Positive** to easily get access to guidelines and implement decision-support using computers at work

● **Fear** that the “A Decision Support” requires more working time and double-work

● Fear a complicated program that requires substantial computer training and extensive instructions
1: “We need this system, Nowadays electronic tools are the solution, because in most areas we do not have access to paper and books, so I think that we should go ahead with this new technology.” (Female midwife-assistant)

2: “During the test of the CDSS, we saw that the software prolonged the consultation time. I mean it takes a lot of time to fill all the information asked.” (Male nurse)
”I was in one facility where they have a poster on the breast-feeding on the wall, so it was very easy to see treatment recommendations. Here we need to check guidelines in books, which is not especially when we are face to face with a patient (female midwife-assistant)”
Fundamental study on what decision support with impact

‘Too much, too late’: mixed methods multi-channel video recording study of computerized decision support systems and GP prescribing

James Hayward, ¹ Fionagh Thomson, ¹ Heather Milne, ¹ Susan Buckingham, ¹ Aziz Sheikh, ¹ Bernard Fernando, ¹ Kathrin Cresswell, ² Robin Williams, ³ Hilary Pinnock ¹

J Am Medical Informatics Association 2013
Alerts needs to be timely!

Results 132 prescriptions were issued in the course of 73 of the consultations, of which 81 (61%) attracted at least one alert. Of the total of 117 alerts, only three resulted in the GP checking, but not altering, the prescription. CDSS provided information and safety alerts at the point of generating a prescription. This was ‘too much, too late’ as the majority of the ‘work’ of prescribing occurred prior to using the computer. By the time an alert appeared, the GP had formulated the problem(s), potentially spent several minutes considering, explaining, negotiating, and reaching agreement with the patient about the proposed treatment, and had possibly given instructions and printed an information leaflet.

Discussion CDSS alerts do not coincide with the prescribing workflow throughout the whole GP consultation. Current systems interrupt to correct decisions that have already been taken, rather than assisting formulation of the management plan.
Disposition

- Needs

- Progress

- Future
Two examples stand out:
1. Telemedicine
2. Use of virtual reality environments

Telemedicine is the use of ICT to deliver health care at a distance. Asynchronous: sharing at different times. Synchronous: takes place in real-time through videoconferencing as an example.
Successful e-health innovations: Africa takes the lead?

- **Easy access** to **knowledge** and information
- **Distance linkage and consultations** for healthcare staff, patients and medical researchers
- Tools for **documentation**
- Tools for **logistics and organization** of medical services
“Innovation has often been split into two categories—product innovation, relating to new objects, and process innovation, whereby new approaches allow a product to be more effectively implemented and used”.

What e-health applications are contributing to health in Africa and elsewhere presently?
Guideline as decision-support for maternal and neonatal care

Consider the following advice - Part 1 of 5

The woman may suffer from severe pre-eclampsia

<table>
<thead>
<tr>
<th>Signs</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure first reading: 200/110 mmHg</td>
<td>Give magnesium sulphate</td>
</tr>
<tr>
<td>Proteinuria</td>
<td>Give appropriate anti-hypertensives</td>
</tr>
<tr>
<td></td>
<td>Revise the birth plan</td>
</tr>
<tr>
<td></td>
<td>Refer urgently to hospital</td>
</tr>
</tbody>
</table>

The woman may suffer from moderate anemia

<table>
<thead>
<tr>
<th>Signs</th>
<th>Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured hemoglobin value: more than 11 g/dl</td>
<td>Give double dose of iron (1 tablet twice daily) for 3 months</td>
</tr>
<tr>
<td>Conjunctival pallor on head</td>
<td>Counsel on compliance with treatment</td>
</tr>
<tr>
<td></td>
<td>Give appropriate oral antimalarial if not given in the past month</td>
</tr>
<tr>
<td></td>
<td>Reassess at next antenatal visit (4-6 weeks). If anemia persists, refer to hospital</td>
</tr>
</tbody>
</table>

Qualmat EU-project
Barriers to greater use of technology

**Barrier 1**
Necessary technology does not exist

**Funding issues**
Insufficient funding devoted to develop necessary technology

**Push factors**
Decrease cost to developer

**Pull factors**
Increase potential reward for developer

**Scientific issues**
Necessary scientific breakthroughs not yet achieved

**Barrier 2**
Technology exists, but is not accessible

**Cost**
The cost of the technology is too high for widespread adoption

**Challenges of distribution**

**Inadequate human resources**

**Unreliable energy supply**

**Barrier 3**
Accessible technology is not adopted

**Cultural resistance**
Technology conflicts with prevailing tradition

**Human inertia**
Reluctance to change practices to benefit from a new technology

Figure 4.
Barriers to greater use of technology for global health
Disposition

● Needs

● Progress

● Future
Appropriate and feasible challenge!

1500 mothers die daily giving birth worldwide.

Work initiated in AU building in Addis December 2, 2013
Provide easy access to guidelines at point of care

- **Guideline**= recommended practices for diagnosis and treatment of important diseases and conditions and for prevention of diseases and promotion of health

- Usually initiated and endorsed by WHO and with national and regional adaptations

- Numerous (105 from recent years listed by WHO), not available in rural areas, gain from ”interactive WWW-approach”
# Guideline to treat children's diseases I: flow approach

## Integrated Management of Childhood Illness

### Child Aged 2 Months Up to 5 Years

**Assess and Classify the Sick Child**
- Assess, Classify and Identify Treatment
- Check for General Danger Signs
- Then Ask About Main Symptoms:
  - Does the child have cough or difficult breathing?
  - Does the child have diarrhoea?
  - Does the child have fever?
  - Does the child have an ear problem?
- Then Check for Malnutrition and Anaemia
- Then Check the Child’s Immunization Status
- Assess Other Problems

**Treat the Child**
- Teach the mother to give oral fluids at home:
  - Oral Antibiotic
  - Ciprofloxacin
  - Iron
  - Co-amoxiclav
  - Bismuth salicylate
- Teach the Mother to Treat Local Infections at Home:
  - Clear the ear by dropper and give antiseptic
  - Treat for mouth ulcers and thrush
  - Soothe the eye with safe remedy
  - Treat eye infection
- Give Preventive Treatments in Clinic:
  - Vitamin A
  - Multivitamins
- Give Emergency Treatment in Clinic only:
  - Quinine for severe malarial
  - Intramuscular antibiotic
  - Diazepam for convulsions
  - Treat low blood sugar

**Follow-up Care**
- Pneumonia
- Dysentery
- Persistent diarrhoea
- Malaria
- Fever: malaria unlikely
- Measles with eye or mouth complications
- Ear infection
- Feeding problem
- Anaemia
- Paller
- Very low weight
- Severe uncomplicated malnutrition

### Sick Young Infant Aged Up to 2 Months

**Assess, Classify and Treat the Sick Young Infant**
- Assess, Classify and Identify Treatment:
  - Check for Severe Disease and Local Infection
  - Then check for Jaundice
  - Then ask: Does the young infant have diarrhoea?
  - Then check for Feeding Problem or Low Weight for Age
  - Then check the young infant’s immunization status
  - Assess Other Problems
- Treat the Young Infant and Counsel the Mother:
  - Intramuscular antibiotic
  - Treat the young infant to prevent low blood sugar
  - Keep the young infant warm on the way to hospital
  - Oral antibiotic
  - Treat local infections at home
  - Correct positioning and attachment for breastfeeding
  - Teach mother to express breast milk
  - Teach mother how to feed by cup
  - Teach the mother to keep the low weight infant warm at home
  - Advice mother to give home care to the young infant
- Give Follow-up Care for the Sick Young Infant:
  - Local Bacterial Infection
  - Jaundice
  - Diarrhoea
  - Feeding Problem
  - Low Weight for age
  - Thrush

**Recording Forms:** Sick Child, Sick young infant
Guideline II

ASSESS AND CLASSIFY THE SICK CHILD
AGED 2 MONTHS UP TO 5 YEARS

ASK THE MOTHER WHAT THE CHILD'S PROBLEMS ARE
• Determine whether this is an initial or follow-up visit for this problem.
  - If follow-up visit, use the follow-up instructions on TREAT THE CHILD chart
  - If initial visit, assess the child as follows:

CHECK FOR GENERAL DANGER SIGNS

ASK:
• Is the child able to drink or breastfeed?
• Does the child vomit everything?
• Has the child had convulsions?

LOOK:
• See if the child is lethargic or unconscious.
• Is the child consoling now?

A child with any general danger sign needs URGENT attention: complete the assessment and
any pre-referral treatment immediately as that referral is not delayed.

THEN ASK ABOUT MAIN SYMPTOMS:
Does the child have cough or difficult breathing?

If YES, ASK:
• For how long?

LOOK, LISTEN, FEEL:
• Count the breaths in one minute.
• Look for chest indrawing.
• Look and listen for stridor.
If wheezing and either fast breathing or chest indrawing:
• Give a trial of rapid-acting inhaled bronchodilator for up to
  three times 15-20 minutes apart. Count the breaths and
  look for chest indrawing again, and then classify.

CLASSIFY COUGH or DIFFICULT BREATHING

CHILD MUST BE CALM

• Any general danger sign OR
• Child indrawing OR
• Stridor in a calm child

SEVERE PNEUMONIA OR VERY SEVERE DISEASE

Additional signs:
• Fast breathing

TREATMENT

• Give first dose of an appropriate antibiotic
• Refer URGENTLY to hospital

PNEUMONIA

• Fast breathing

TREATMENT

• Give oral antibiotic for 3 days
• If wheezy (even if it disappeared after rapid acting bronchodilator) give an inhaled bronchodilator for 5 days*
• Soothe the throat and relieve the cough with a safe remedy
• If coughing for more than 3 weeks or if having recurrent
  wheezing, refer for assessment for TB or asthma
• Advise the mother when to return immediately
• Follow up in 2 days

COUGH OR COLD

• No signs of pneumonia or severe disease

TREATMENT

• If wheezing (even if it disappeared after rapid acting bronchodilator) give an inhaled bronchodilator for 5 days*
• Soothe the throat and relieve the cough with a safe remedy
• If coughing for more than 3 weeks or if having recurrent
  wheezing, refer for assessment for TB or asthma
• Advise the mother when to return immediately
• Follow up in 6 days (not empirical)

*In settings where inhaled bronchodilator is not available, oral salbutamol may be the second choice.

In settings where inhaled bronchodilator is not available, oral salbutamol may be the second choice.
Guideline III

Standard document not useful - as most guidelines

Excellent from chart

Infant feeding

Exclusive breastfeeding

A systematic review of current scientific evidence on the optimal duration of exclusive breastfeeding identified and summarized studies comparing exclusive breastfeeding for four to six months versus six months, in terms of growth, infant iron status, morbidity, atopic disease, motor development, postpartum weight loss and anemia (1). The evidence did not suggest an adverse effect of exclusive breastfeeding for six months on infant growth as an overall population basis. The available data suggested that exclusive breastfeeding for six months has a protective effect against gastrointestinal infection in developing and developed countries and offered an advantage to the mother in prolonging the duration of lactational amenorrhea (1).

An expert consultation on the optimal duration of exclusive breastfeeding, considering the results of the systematic review, concluded that exclusive breastfeeding to six months conferred several benefits to the infant and mother (2). In 2002, the World Health Assembly endorsed the recommendation of exclusive breastfeeding for six months with the introduction of complementary foods and continued breastfeeding thereafter (3).

Studies that assessed the effect of not breastfeeding on the risk of death due to infectious diseases in Brazil, The Gambia, Ghana, Pakistan, the Philippines and Senegal were analysed. Protection provided by breast milk declined steadily with age during infancy (pooled odds ratios: 5.8 [95% CI 3.4-9.6] for infants <2 months of age; 4.1 [95% CI 2.7-6.4] for 2-3 months of age; 7.6 [95% CI 6.3-9.2] for 4-5 months of age; 8.5 [95% CI 6.5-12.4] for 6-8 months of age; and 14 [95% CI 8.6-24.2] for 9-11 months of age). In the first six months of life, protection against diarrhoea was substantially greater (odds ratios 6.1) than against deaths due to acute respiratory infections (odds ratios 1.6) (4).

A research study in India included eight communities randomized to either receive intervention in training and counselling on breastfeeding or no intervention. 1115 infants were included. 59% in the intervention and 473 in control communities. At three months, exclusive breastfeeding rates were 76% in the intervention and 48% in control communities (OR 4.0, 95% CI 3.0-5.5, p < 0.0001). The 7-day diarrhoea prevalence was lower in the intervention than in the control community at three months (0.64, 95% CI 0.44-0.95, p = 0.028) and six months (0.85, 95% CI 0.72-0.99, p < 0.004). The mean weights and lengths, and the proportion with weight-for-height or height-for-age Z scores of 2 or less, at age three months and six months did not differ much between groups (5).
Ways to simplify and streamline

Classify cough or difficult breathing

- Does the child have fast breathing?
  - Yes
  - No

- Does the child have a cough?
  - Yes
  - No

Cough or difficult breathing classified

- Are there any general danger signs present?
- Is there chest indrawing?
  - Yes
  - No

  If present, give a trial of rapid acting inhaled bronchodilator for up to three times 15-20 minutes apart. Count the breaths again and look for chest indrawing again, then classify.

- Is there stridor in a calm child?

Severe pneumonia or very severe disease

Give first dose of an appropriate antibiotic; Refer URGENTLY to hospital.
Part of Community Health Portal

Drug Management Application

On-the-job training
Public investments are needed
Conclusions

- **Technology Acceptance Model (TAM)** by Davies et al from 1980s seems valid for e-health applications
  - Perceived usefulness
  - Perceived ease of use
  - Demonstrated across countries and we hypothesize its relevance in resource-strained countries

- **Systematic model to be applied for development and use** of e-health tools in Africa: 1. assessment needs/attitudes, 2. evaluations and 3. establish ”Good Clinical Decision Support Practice”

- Establish Community Health Portal for e-health tools and information/knowledge sharing