

<b>Name of Intervention</b> <b>Authors (Year)</b>	<b>Study design</b>	<b>Country</b> <b>Health Domain</b> <b>Target Group</b>	<b>Type and Characteristics of mCDSS<sup>a</sup></b>	<b>Expected Outcome</b>	<b>Reported Outcomes</b>
m4Change <sup>b</sup> McNabb et al (2015) [25]	Quantitative pre-post study	Nigeria Maternal Health CHEW/HCWs	-Mobile phone and Tablet -Guided decision support with algorithms for ANC and client data -Health education audio clips for client counselling -Local language support -Offline functionality -Password protected	-Effect on quality of ANC services -Effect on client satisfaction	-Generally, quality score improved significantly by about 4 points (from 13.3 at baseline to 17.2 at endline) -Not all specific elements of the score significantly improved -Client satisfaction with ANC services significantly improved at end line.
DESIRE (Decision Support and Integrated Record-keeping) Vedanthan et al (2015) [26]	Qualitative usability and feasibility study	Kenya Hypertension Nurses and Clinical Officers	-Tablet-based patient-specific decision-support tool with branching logic algorithm, alerts and reminders. -Integrated with patient data and linked to a central medical records -Offline functionality -Data security via user-authentication, automatic timeouts, encryption and secure transmission system	-Identification of barriers and facilitators to implementing the DESIRE tool	-Technical and human barriers to implementation were identified. -Feasibility themes included facilitators to implementation, provider or patient issues and additional feature requests -Twenty-one unique critical incidents identified in usability testing.

CommCare Svoronos et al (2010) [27]	Qualitative and descriptive	Tanzania  Maternal Health  CHWs	-Phone-based CommCare application including user-controlled guided decision support tool, checklist and follow-up reminders for quality improvement -Use of patient data for referral support and monitoring -Supervisory feedback and report generation -Offline functionality -Password protected	-Develop CommCare module	-Application was well received by CHWs and found to improve and standardize service delivery (identification, follow up and referral) -Ease and comfort of use reported after some training -Use of tool declined postimplementation
mPneumonia Ginsburg et al (2015) [28]	Mixed methods usability and feasibility testing	Ghana  Childhood Illnesses  Lesser trained health care professionals	-Tablet-based tool with IMCI algorithm and decision-making protocol -Coupled with “intelligent” electronic breath counter and paediatric pulse oximeter with visual, auditory, and vibratory feedback -Offline functionality -English language support -Password protected	-Design and development of mPneumonia to improve diagnostic accuracy and facilitate guideline adherence by HCWs.	-HCWs positively responded to the mCDSS and found it innovative and easy. -HCWs preferred it to standard (paper) practice, anticipating accurate and easier care management -Concerns about maintenance and theft -Identified 17 critical and 9 noncritical usability issues -Increased ease of use with repetition -Suggested at least 2 days (16.3hours) of training

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Bacis (Basic Antenatal Care Information System)	Before and after cohort study	South Africa  Maternal Health	<ul style="list-style-type: none"> <li>-Electronic patient information system with clinical decision support for maternal health via protocols, checklists, and a rule and knowledge base with alerts and reminders</li> <li>-Supports patient data entry for classification, follow-up and referral, with validation and completeness checks</li> </ul>	<ul style="list-style-type: none"> <li>-Usability and acceptability review</li> <li>-Compliance (i.e. completion and response) performance for maternity care protocols and the antenatal care checklist</li> </ul>	<ul style="list-style-type: none"> <li>-Improved compliance from 85% to 89% although not statistically significant</li> <li>-Out of nine specific categories for measuring compliance, three (compliance at booking, patients &lt;18 years &amp; booking patients after week 20) showed statistically significant results compared to standard practice using paper</li> <li>-Better suited for younger computer literate workers</li> </ul>
Horner et al (2013) [29]		Nurses			
TB Tech  Catalani et al (2014) [30]	Mixed methods human-centred design	Kenya  Tuberculosis & HIV	<ul style="list-style-type: none"> <li>-Patient-specific decision support for provider action, education and behaviour change.</li> <li>-Integrated paper-based processes with electronic medical record.</li> <li>-Supported with educational and motivational information for HCW</li> <li>-Additional inputs including facility staffing and hardware upgrades, supply chain management and provision of mobile radiology units and educational campaign for providers</li> </ul>	<ul style="list-style-type: none"> <li>-Develop, design and pilot test TBTech using a human-centred design approach</li> </ul>	<ul style="list-style-type: none"> <li>-Positive disposition of clinicians to medical record and decision support system</li> <li>-Concerns regarding accuracy and actionability of recommendations</li> <li>-Health system challenges such as unavailability of tests, low staffing and supplies resulted in delayed action and some unactionable recommendations.</li> </ul>
		Clinicians			

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txt2MEDLINE Armstrong et al (2012) [31]	Pre-post utility evaluation	Botswana  Multiple domains  Clinicians of varying cadres	-Mobile phone-based two-way Short Messaging Service (SMS) of clinical guidelines, with MEDLINE query function.	-Usability and usefulness of intervention	-Although pre-intervention study recorded high intention to use, this declined during the one-month trial
ALMANACH Shao et al (2015a, 2015b) [32,33]	Controlled non- inferiority trial and qualitative study	Tanzania  Childhood Illnesses  Clinicians	-Smartphone or tablet -Electronic medical record system with modified version of IMCI algorithm -Supported by point-of- care tests and simple clinical assessments	-Primary outcomes: proportion of children cured at day 7 and proportion of children who received antibiotics on day zero -Secondary outcomes: proportion of children who were admitted secondarily or who died, and proportion of children who received antibiotics during the study period -Barriers and facilitators to uptake of algorithm and differences between tablets and phones	-Antibiotic prescription reduced by 80% and study reported better clinical outcomes due to increased compliance to guidelines compared to usual practice -Ease and comfort of use, with sustained rational judgment despite certain recommendations by the system -HCWs reported that it made their work efficient and effective compared to usual practice, but raised concerns about increased consultation time and lack of financial incentives for using the service -Patients trust in service delivery improved, although health system constraints hindered completion of the actions and was demotivating

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<p>eIMCI</p> <p>Mitchell et al (2012); Mitchell et al (2013); DeRenzi et al (2008) [34-36]</p>	<p>Mixed methods before-after cluster trial</p>	<p>Tanzania</p> <p>Childhood Illnesses</p> <p>Health care professionals</p>	<p>-Personal Digital Assistant with guided decision support using Electronic IMCI protocols for stepwise examination, diagnosis and management.</p> <p>-Algorithm included prompts based on data input.</p> <p>-Language support in English and Swahili</p>	<p>-Perceptions of HCW and caretakers to eIMCI compared to standard paper formats</p> <p>-Adherence to eIMCI guidelines compared to paper formats</p> <p>-Impact of mHealth on quality of IMCI implementation (measured as complete assessment on 15 critical items of the IMCI)</p>	<p>-HCWs were positively predisposed to using the eIMCI; finding it faster and easier, and appreciating the stepwise guidance</p> <p>-Caretakers reported improved assessment of their children and perceived that the eIMCI enhanced provider knowledge and skill</p> <p>-Increased trust and confidence of caretakers in care provided.</p> <p>-Some HCWs reported challenges with eIMCI recommendations that contradicted their preferred course of management</p> <p>-Protocol adherence using eIMCI showed statistically significant improvement from 61%-98% in paper format, to 92%-100%.</p> <p>-Completeness of assessment improved from 21% in the paper format to 71%, and was consistent across study clinics.</p> <p>-Consultation time was not significantly different between the paper system (8.98minutes) and the eIMCI (9.06minutes)</p>
<p>Text Messaging of Malaria Guidelines</p> <p>Jones et al (2012); Zurovac et al (2012); Zurovac et al (2011) [37-39]</p>	<p>Cluster randomised controlled trial</p>	<p>Kenya</p> <p>Malaria</p>	<p>-One-way SMS guidelines for outpatient management of malaria, supported by unique motivational messages</p> <p>-English Language</p>	<p>-HCW perceptions, experiences and drivers of change of intervention</p> <p>-Improved and maintained adherence guidelines for outpatient paediatric malaria</p> <p>-Correct management with</p>	<p>-Improvement in correct management (24%), which was sustained (25%) up to 6months later</p> <p>-Major improvements in tasks related to dispensing and counselling</p> <p>-HCW responded to the intervention with enthusiasm, perceiving it as innovative, relevant and useful</p>

Health workers

artemether-lumefantrine  
and effective counselling

-Most HCW were happy with content, frequency and timing of messages with few concerns about repetition and monotony  
-Intervention cost amounted to about US \$19,000, most (45%) of which was for development and pre-testing. Cost per additional child correctly managed was US \$0.50

QUALMAT  
(Quality of  
Maternal and  
Prenatal Care)

Mixed methods  
quasi-  
experimental  
study

Tanzania, Ghana  
and Burkina Faso

-Guided computer-based decision support system integrated with patient data and algorithmic function for care management (antenatal till early postnatal care) and monitoring.  
-Includes educational training materials for health workers and an electronic partograph.  
-Additional intervention components include solar power, regular technical supervision, and performance-based incentives (PBI)

-Usability, acceptance and impact study  
-Assessment of effect on workflow  
-Improved quality of care through improved competence and motivation of HCW

*General Findings*

-No clear difference between pre- and post-intervention quality scores and scores at non-intervention facilities.  
-Some variables were inconsistently statistically significant (e.g. in only one study arm, being pre- or post-intervention or intervention, non-intervention)  
-Post-intervention history taking, monitoring of mother, total technical and inter-personal performance scores were significantly better but remained unsatisfactory  
- Only care and examination of the newborn scored significantly better between intervention and non-intervention quality scores  
-Use of mCDSS was acceptable and feasible  
-Combining mCDSS and PBI did not improve quality of antenatal care

Blank et al (2013);  
Dalaba et al  
(2014); Dalaba et  
al (2015); Mensah  
et al (2015);  
Saronga et al  
(2015); Zakane et  
al (2014);  
Duysburgh et al  
(2016) [40-46]

Maternal and  
Prenatal Health

Health  
professionals  
(non-physicians)

*Ghana*

-Decreased proportion of delivery complications (from 10.7% to 9.6%)

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deaths (from 4 to 1).  
-48% of financial implementation cost (apprx. US \$23,000) was for pre-intervention expenses  
-No significant increase in consultation time for ANC compared to control sites

#### *Tanzania*

-Total financial cost of implementation was about US \$185,000, 77% of which covered pre-intervention expenses.  
-No significant increase in consultation time for ANC in intervention sites compared to control sites

#### *Burkina Faso*

-HCW received mCDSS enthusiastically, expecting it to improve skill and over-reliance on referring patients.  
-Providers resisted use due to perceived increased workload and complexity of using the system

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<sup>a</sup>mCDSS: mobile clinical decision support system.

<sup>b</sup>Although the m4Change study also used the CommCare app, we decided to treat them as independent studies because the interventions were only similar on a technical level and not part of an integrated multicountry study.

#### **Abbreviations**

ANC- Antenatal Care

CHEWs- Community Health Extension Workers

CHWs- Community Health Workers

HCWs- Health care Workers

IMCI- Integrated Management of Childhood Illness

mCDSS- mobile clinical decision support system

PHCs- Primary Healthcare Centre's