

Evaluating mobile solutions of integrated Community Case Management (iCCM): Making the final connection

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The current state of iCCM

Acknowledging a shortage of clinicians and inequitable access to basic health care for many communities in low- and middle-income countries (LMICs), the World Health Organization and United Nations Children's Fund developed integrated Community Case Management (iCCM)¹. iCCM is a paper-based clinical decision rule that is deployed by frontline community health workers (CHWs) in hard-to-reach locations. The components of the decision rule are sufficiently simple for CHWs who are educated to secondary school level (with 6 days statutory iCCM training)² to be able to manage uncomplicated illnesses in the community, and urgently refer seriously ill children to higher-level facilities for more comprehensive medical attention.

Rolled out in the early 2000s³ across Asia and sub-Saharan Africa, iCCM (and its related decision rule, Integrated Management of Childhood Illness (IMCI)) contributed to notable progress towards achieving Millennium Development Goal 4⁴. Despite significant reductions in under-5 morbidity and mortality between 1990 and 2015⁵, the overall impact of iCCM on childhood survival in LMICs is undermined by a variety of factors. These include poor CHW adherence to guidelines^{6,7}, incomplete patient recording, cumbersome monthly aggregation and reporting of cases to district health offices, as well as infrequent training opportunities to retain and develop skills, and irregular supervisory support⁸. This has prompted innovative strategies in attempts to optimize iCCM delivery.

The potential of mobile solutions for iCCM

Increased affordability and functionality of mobile phones and improved internet/data coverage in sub-Saharan Africa have made them a potential solution for circumventing some of the existing challenges of paper iCCM implementation. Mobile solutions of iCCM have been reported to improve both observed and perceived CHW adherence to iCCM and IMCI guidelines, accuracy of illness classification^{9,10}, and speed of consultation¹¹, when compared to the paper counterparts. Interviews with CHWs and caregivers of sick children have revealed a belief that mobile iCCM improves explanations of treatment recommendations to caregivers¹², and could enhance recording of patient visits in village clinic registers¹³. Additional perceived benefits include reduced time costs associated with automating aggregation of cases and data submission compared to existing manual procedures, and providing opportunities for more regular feedback and advice from supervisors through exploitation of SMS platforms^{13,14}.

However, existing research evaluating mobile solutions of iCCM is of mixed quality (e.g. few explanatory and confirmatory experimental studies, small sample sizes and observation periods, lack of a control). This casts into question the robustness of the evidence. Some shortcomings may be attributed to methodological choices during study design. But on balance, lack of desired rigor is largely the by-product of inherent imperfections of evaluating a complex intervention in settings where it is difficult to control the influence of extraneous variables¹⁵. Appraising 'quality' is arguably further complicated by the absence of consensus standards for evaluating and reporting mobile health interventions¹⁶, and the ongoing contention between hierarchies of evidence and appropriateness¹⁷.

Interoperability as the final connection

A nuance of the 'standards of evidence needed to implement' debate that has received less attention has been a failure to demonstrate, or report on, interoperability of iCCM applications with country-specific district and national health information systems (HIS) (e.g. the DHIS 2)¹⁸. The disease-reporting pathway for iCCM begins with presentation of a sick child for assessment at village clinics and ends when data is available for use by centralized bodies for disease surveillance. Therefore, failure to evaluate connected mobile solutions means interventions for iCCM are only partly being tested under their intended real-world conditions. In LMICs such as Malawi, the ability of CHWs to perform each of the required iCCM steps from assessment through to case reporting precludes standalone evaluation of such mobile solutions for these guidelines. As with most countries, the Malawi Ministry of Health requires a record of every patient visit. Without the ability to send data electronically to local HIS, options for evaluating such interventions may be restricted to the inclusion of both modalities for assessing and treating children under-5.

Several programs of work (in Malawi¹⁹ and Uganda²⁰) have either adopted double assessment and data entry approaches, or have utilized mobile iCCM to direct assessment and data entry into patient records. Whilst it is impossible to speculate on why these procedures were selected in these instances (interoperability may or may not have been the rate limiting step), the authors can identify that lack of interoperability was a crucial determinant of the decision to investigate the added value of a mobile version of iCCM in a feasibility study and clinical trial, as part of the

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Supporting LIFE program²¹. Whilst adding or integrating mobile iCCM with paper iCCM generates some insight into the potential benefits, we have limited understanding of relationships between mobile versions of iCCM and most clinical, process, patient-reported and cost-related outcome measures. Furthermore, without interoperability, or at least cognizance of the challenges of how mobile solutions might be able to work together with existing health IT systems, we have insufficient information to establish their real-world acceptability, feasibility, effectiveness and sustainability locally, as well as their utility in other countries²².

Reasons for failing to integrate mobile solutions of iCCM can be attributed to a mixture of technical, financial, regulatory and local political factors (often hindered by lack of a country-level HIS). This may involve lengthy and complicated negotiations with multiple stakeholders, which may be at odds with external organizations with specific agendas of satisfying funding objectives. In the authors' case, proving end-to-end functionality with sufficient confidence and in time for standalone evaluation in a clinical trial was not possible.

Interoperability of mobile solutions of iCCM with district and national HIS, needs to be prioritized. Whilst use of both mobile and paper iCCM in the diagnostic work-up of children has been viewed as acceptable to CHWs in previous research¹³, the practical and financial sustainability of this approach, should be carefully considered. If the standalone potential of these types of interventions is to be truly determined, and a compelling case made for government and investor "buy-in", establishing whether interoperability is achievable needs to be part of programmatic research agendas and supported by local leadership. Exploration of the compatibility and readiness of country-level HIS to support connected systems also warrants investigation. Finally, open architecture more conducive to interoperability is worthy of consideration for leveraging connectedness between programs that are siloed from each other, as well as health systems²³.

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References

1. Marsh DR, Hamer DH, Pagnoni F, Peterson S. Introduction to a Special Supplement: Evidence for the Implementation, Effects, and Impact of the Integrated Community Case Management Strategy to Treat Childhood Infection. *Am. J. Trop. Med. Hyg.* doi:10.4269/ajtmh.2012.12-0504
2. Buchner DL, Brenner JL, Kabakyenga J, Teddy K, Maling S, Barigye C, et al. Stakeholders' Perceptions of Integrated Community Case Management by Community Health Workers: A Post-Intervention Qualitative Study. *PLoS ONE*; 2012;87(5 Suppl):2-5. doi:10.1371/journal.pone.0098610
3. Bennett S, Dalglis SL, Juma PA, Rodriguez DC. Altogether now... understanding the role of international organizations in iCCM policy transfer. *Health Policy Plan*. 2014;9(6);doi: 10.1093/heapol/czv071
4. Amouzou A, Kanyuka M, Hazel E, Heidkamp R, Marsh A, Mleme T, et al. Independent Evaluation of the integrated Community Case Management of Childhood Illness Strategy in Malawi Using a National Evaluation Platform Design. *Am. J. Trop. Med. Hyg.* 2016;94(3):574-83;doi:10.4269/ajtmh.15-0584

5. United Nations. The Millenium Development Goals Report New York, 2015. [http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20\(July%201\).pdf](http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf)
6. Wanduru P, Tetui M, Tuhebwe D, Ediau M, Okuga M, Nalwadda C, et al. The performance of community health workers in the management of multiple childhood infectious diseases in Lira, northern Uganda – a mixed methods cross-sectional study. *Glob Health Action*. 2016;9(1):33194. doi: 10.3402/gha.v9.33194
7. Chinbuah MA, Abbey M, Kager PA, Gyapong M, Nonvignon J, Ashitey P, et al. Assessment of the adherence of community health workers to dosing and referral guidelines for the management of fever in children under 5 years: a study in Dangme West District, Ghana. 2013;5(2):148-56. *Int Health* 10.1093/inthealth/ihs008
8. Nsona H, Mtimuni A, Daelmans B, Callaghan-Koru JA, Gilroy K, Mgalula L, et al. Scaling up integrated community case management of childhood illness: update from Malawi. *Am J Trop Med Hyg.* 2012;87(5 Suppl):54-60, doi: 10.4269/ajtmh.2012.11-0759
9. Mitchell M, Hedt-Gauthier BL, Msellemu D, Nkaka M, Lesh N. Using electronic technology to improve clinical care - results from a before-after cluster trial to evaluate assessment and classification of sick children according to Integrated Management of Childhood Illness (IMCI) protocol in Tanzania. *BioMed Central (this abbreviation should still be followed by Medical Informatics and Decision Making)*; 2013;13:95. <http://www.biomedcentral.com/1472-6947/13/95>
10. Mitchell M, Getchell M, Nkaka M, Msellemu D, Van Esch J, Hedt-Gauthier B. Perceived improvement in integrated management of childhood illness implementation through use of mobile technology: qualitative evidence from a pilot study in Tanzania. *J Health Commun.* 2012;17 Suppl 1:118-27. doi: 10.1080/10810730.2011.649105
11. DeRenzi B, Lesh N, Parikh T, Sims C, Maokla W, Chemba M, et al. e-imci: Improving pediatric health care in low-income countries. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*; Florence, Italy. 1357174: ACM; 2008. p. 753-62.
12. Perri-Moore S, Routen T, Shao AF, Rambaud-Althaus C, Swai N, Kahama-Marro J, et al. Using an eIMCI-Derived Decision Support Protocol to Improve Provider-Caretaker Communication for Treatment of Children Under 5 in Tanzania. *Glob Health Commun*; 2015;1(1):41-7. doi: 10.1080/23762004.2016.1181486
13. Chirambo GB, Hardy V, Heavin C, O'Connor Y, O'Donoghue J, Mastellos N, Tran T, Hsieh J, Wu T-S J, Carlsson S, Andersson B, Muula AS, Thompson M. Perceptions of a Mobile Health Intervention for Community Case Management in Malawi: Opportunities and Challenges for Health Surveillance Assistants in a Community Setting. *Malawi Med J : the journal of Medical Association of Malawi*. Accepted October 29, 2017 (in press).
14. Pimmer C, Mhango S, Mzumara A, Mbvundula F. Mobile instant messaging for rural community health workers: a case from Malawi. *Glob Health Action*; 2017;10(1):1368236. doi: 10.1080/16549716.2017.1368236
15. Maar MA, Yeates K, Perkins N, Boesch L, Hua-Stewart D, Liu P, et al. A Framework for the Study of Complex mHealth Interventions in Diverse Cultural Settings. *JMIR mHealth and uHealth*; 2017;5(4):e47. doi:10.2196/mhealth.7044.
16. Brinkel J, Krämer A, Krumkamp R, May J, Fobil J. Mobile Phone-Based mHealth Approaches for Public Health Surveillance in Sub-Saharan Africa: A Systematic Review. *Int. J. Environ. Res. Public Health*; 2014;11(11):11559-82. doi:10.3390/ijerph111111559
17. Parkhurst JO, Abeysinghe S. What Constitutes "Good" Evidence for Public Health and Social Policy-making? From Hierarchies to Appropriateness. *Social Epistemology*; 2016;30(5-6):665-79. doi:10.1080/02691728.2016.1172365
18. Guenther T, Laínez YB, Oliphant NP, Dale M, Raharison S, Miller L, et al. Routine monitoring systems for integrated community case management programs: Lessons from 18 countries in sub-Saharan

- Africa. *J Glob Health*; 2014;4(2):020301. doi: 10.7189/jogh-04-020301
19. Haas S. *mHealth Compendium. Special Edition 2016: Reaching Scale USAID*; May 2016. http://www.africanstrategies4health.org/uploads/1/3/5/3/13538666/2016_mhealth_31may16_final.pdf
20. Kabakyenga J, Barigye C, Brenner J, Maling S, Buchner D, Nettle-Aquirre A, et al. A demonstration of mobile phone deployment to support the treatment of acutely ill children under five in Bushenyi district, Uganda. *Afr Health Sci*; 2016;16(1):89-96 doi: 10.4314/ahs.v16i1.12
21. Hardy V O' Connor Y, Heavin C, Mastellos N, Tran T, O'Donoghue J, et al. The added value of a mobile application of Community Case Management on under-5 referral, re-consultation and hospitalization rates in two districts in Northern Malawi: study protocol for a pragmatic cluster-randomized controlled trial. *Trials*; 2017;(in press). doi:10.1186/s13063-017-2213-z
22. Agarwal S, LeFevre AE, Lee J, L'Engle K, Mehl G, Sinha C, et al. Guidelines for reporting of health interventions using mobile phones: mobile health (mHealth) evidence reporting and assessment (mERA) checklist. *BMJ*; 2016;352:i1174. doi: 10.1136/bmj.i1174
23. Estrin D, Sim I. Health care delivery. Open mHealth architecture: an engine for health care innovation. *Science*; 2010;330(6005):759-60. doi: 10.1126/science.1196187
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