Integrated Management of Childhood Illness (IMCI) in the 21st Century
A Review of the Scientific and Programmatic Evidence

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COVER PHOTO: Maternity clinic in Malawi. By Dr Alasdair Campbell, member of the Edinburgh University’s Global Health Society (EUGHS).
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Stock supply in child health clinic in rural China. Photo by Dr Kit Yee Chan, member of the Edinburgh University's Global Health Society (EUGHS).
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Executive Summary

Integrated management of childhood illness (IMCI) was developed by the WHO and UNICEF in the mid-1990s as a strategy to reduce under-five mortality. Aimed at countries with mortalities >40/1000 live births, it has been adopted by more than 100 countries. Repeated evaluations have demonstrated that IMCI can improve the quality of clinical care for sick children, but problems related to implementation at scale in low-resource settings have too often prevented IMCI (and especially integrated management of neonatal and childhood illness - IMNCI, and integrated community case management - iCCM) from achieving expected or even demonstrable reductions in mortality.

This working paper synthesizes the latest scientific and programmatic evidence and presents a comprehensive review of the status of IMCI (and IMNCI and iCCM) in the 21st century in low and middle income countries (LMIC). It is the first of a four part working paper series on IMCI.

This paper includes an assessment of the effectiveness of available interventions for IMCI, IMNCI and iCCM, particularly those for childhood pneumonia, diarrhoea and malaria, and also evaluates what we know about the coverage and quality of treatment of sick children in high burden settings. It is clear that highly effective interventions exist and that they could save the lives of many children worldwide. However, there are many reasons why these interventions are not being implemented in a way that would show demonstrable impact, and those reasons are extremely complex. Many challenges in relation to access to health care, training community health workers (CHWs), and ensuring and sustaining their performance and motivation remain to be addressed. Maintaining and coordinating supplies is also a constant challenge. Even when many of these problems are adequately addressed, there are further challenges related to low levels of parental care-seeking behaviour, resulting in diminished effectiveness of IMCI and iCCM programs. There are also challenges with CHWs' recognition of children with danger signs and their referral to hospitals, which is often inadequate.

Challenges related to higher levels of health systems' operations, such as formulating health policy and launching implementation at the national level, or even noting and overcoming resistance to IMCI implementation, are also discussed using relevant examples. There are great difficulties with assessing costs related to IMCI programme implementation in different contexts and involving the private sector to commit more resources in support of IMCI programmes. Recent evaluations of IMCI, IMNCI and iCCM programmes in LMIC settings have shown mixed results. Moreover, the evaluations themselves often haven't been adequately designed and/or powered to show interpretable results. We also reflect upon a recent exercise, using the CHNRI method, where research priorities for iCCM were being set.

Lastly, indicators of coverage and quality of treatment were critically assessed and we concluded that many of them were inadequate and required validation and improvement. Similar issues are relevant to indicators that could assist our understanding of the treatment gap and its contribution to excess mortality.
IMCI: A Review of the Scientific and Programmatic Evidence

1.1. What is the present status of IMCI and IMNCI in high burden settings?

Integrated management of childhood illness (IMCI) was developed by the WHO and UNICEF in the mid-1990s as a strategy to reduce under-five mortality. Aimed at countries with mortalities >40/1000 live births, it has been adopted by more than 100 countries (Chopra et al., 2012). Repeated evaluations have demonstrated that IMCI can improve the quality of clinical care for sick children, but problems related to implementation at scale in low-resource have too often prevented IMCI (and especially IMNCI and iCCM) from achieving expected or even demonstrable reductions in mortality.

As a proof of principle for the large potential effect of IMCI, Egypt's case is often quoted as one of the best examples of successful implementation (Rakha et al. 2013). In Egypt, the Ministry of Health and Population scaled up the Integrated Management of Childhood Illness (IMCI) strategy between 1999 and 2007 in 84% of public health facilities. Across 213 districts included in the analysis, the estimated average annual rate of decline in under-five mortality was 3.3% before as compared with 6.3% after IMCI implementation (p=0.0001). In a sub-sample of 127 districts that started implementing IMCI between 2002 and 2005, the average annual rate of decline of under-five mortality was 2.6% before compared with 7.3% after IMCI implementation (p<0.0001). IMCI implementation also led to marked improvements in the quality of child health services (Rakha et al., 2013). This example demonstrates that a well-designed and nationally scaled IMCI effort can lead to dramatic progress in child mortality reduction within a relatively short amount of time.

Another good example of successful child mortality reduction is Malawi. Kanyuka et al. (2016) conducted a "Countdown to 2015 country case study" of Malawi's progress towards Millennium Development Goal 4. The Malawi National Statistical Office lead an in-depth country case study which aimed to explain the country's success in improving child survival. Child and neonatal mortality for the years 2000-14 were estimated using five district-representative household surveys. The Lives Saved Tool (LiST) was used to attribute the child lives saved in the years from 2000 to 2013 to various interventions. The adoption and implementation of policies and programmes affecting the health of women and children was documented and the estimates of financing were developed. The estimated mortality rate in children younger than 5 years declined from 247 deaths per 1000 livebirths in 1990 to 71 deaths in 2013, with an annual rate of decline of 5.4%. The most rapid mortality decline occurred in the 1-59 months age group, while neonatal mortality declined more slowly (from 50 to 23 deaths per 1000 livebirths), representing an annual rate of decline of 3.3%. Results from the LiST analysis showed that about 280,000 children's lives were saved between 2000 and 2013. This was attributable to interventions including treatment for diarrhoea, pneumonia, and malaria (23%), insecticide-treated bednets (20%), vaccines (17%), reductions in wasting (11%) and stunting (9%), facility birth care (7%), and prevention and treatment of HIV (7%). The authors concluded that the result was achieved mainly through the scale-up of interventions that are effective against the major causes of child deaths (malaria, pneumonia, and diarrhoea), programmes to reduce child undernutrition and mother-to-child transmission of HIV, and some improvements in the quality of care provided around birth.
1.1.1. Effectiveness of available interventions for IMCI, IMNCI and iCCM

There is every reason to expect that mortality reduction should follow the implementation of interventions embedded in IMCI, which should prevent or treat childhood illnesses. Theodoratou et al. (2010) conducted a systematic review of the literature assessing the effect of pneumonia case management on mortality from childhood pneumonia. Their review covered the following interventions: community case management with antibiotic treatment, and hospital treatment with antibiotics, oxygen, zinc and vitamin A. They summarized results from randomized controlled trials (RCTs), cluster RCTs, quasi-experimental studies and observational studies across outcome measures using standard meta-analysis methods. They estimated that community case management of pneumonia could result in a 70% reduction in mortality from pneumonia in 0-5-year-old children.

In addition, Munos et al. (2010) looked into effects of oral rehydration solution (ORS), which should prevent dehydration and reduce the mortality from diarrhoea. They conducted a systematic review to identify studies evaluating the efficacy and effectiveness of ORS and RHFs. A total of 157 papers were included in the meta-analyses of ORS outcomes. They estimated that ORS may prevent 93% of diarrhoea deaths. ORS is effective against diarrhoea mortality in home, community and facility settings. Walker et al. (2010) studied the effects of zinc supplementation on diarrhoea mortality. Using diarrhoea hospitalizations as the closest and most conservative possible proxy for diarrhoea mortality, the authors estimated that zinc as the treatment of diarrhoea could decrease diarrhoea mortality by 23%. Traa et al. (2010) established that ciprofloxacin, ceftriaxone and pivmecillinam, i.e. the antibiotics currently recommended by the World Health Organization (WHO) for the treatment of dysentery in children, should result in a childhood dysentery cure rate of >99%. Thus, they should be expected to decrease diarrhoea mortality attributable to dysentery.

Finally, Eisele et al. (2010) explored the evidence towards the effectiveness of interventions against childhood malaria deaths. Insecticide-treated mosquito nets (ITNs) and indoor-residual spraying (IRS) are recommended strategies for preventing malaria in children. The authors performed two systematic literature reviews in Plasmodium falciparum endemic settings; one to estimate the effect of ITNs and IRS on preventing malaria-attributable mortality in children 1-59 months, and another to estimate the effect of ITNs and IPTp in pregnant mothers and thus preventing neonatal and child mortality through improvements in birth outcomes. Their estimate of the protective efficacy of ITNs and IRS on reducing malaria-attributable mortality in children aged 1-59 months was 55%, in P. falciparum settings, while the effect of the interventions in pregnancy (IPTp and ITNs) was estimated to 35% on reducing the prevalence of low birth weight (LBW) in the first or second pregnancy in areas of stable P. falciparum transmission.

1.1.2. IMCI and IMNCI depend on access to health care

All of the reviews showed rather dramatic potential for pneumonia case management, ORS, zinc, antibiotic treatment of dysentery, ITNs, IRS and IPTp in reducing the mortality from childhood pneumonia, diarrhoea and malaria, respectively. Clearly, both the IMCI, IMNCI and iCCM are strategies that should work well, at least in principle. Unfortunately, in practice, implementation, scaling-up and evaluation of IMCI, IMNCI and iCCM programmes are far from simple. IMCI and IMNCI will critically depend on some level of access to health care
provision, which in many regions simply isn’t a realistic prospect. The success of iCCM in high-burden settings relies on training, performance and motivation of community health workers (CHW) to sustain these programmes. It also critically depends on the support CHWs receive and the availability of ORS, antibiotics, zinc, ITNs and IRS. Finally, the parents themselves should be aware of the symptoms and danger signs and seek care. Several recent reviews attempted to address these bottlenecks and describe the reality of the high-burden context with respect to these critical parameters.

Chandran et al. (2011) assessed the proportion of neonates and children under five years of age in low and middle-income countries (LMIC) with any access to a healthcare facility. Their data suggest that up to 30-40% of all children globally may lack access to health care when sick, making IMCI implementation difficult.

1.1.3. Appropriate training and motivation of CHWs and adequate supply are prerequisites for successful implementation of iCCM

Where access to health care is lacking, iCCM proposes training of community health workers to recognize danger signs and administer treatment at scale. In several well-designed trials, this approach was shown to be both safe and effective, but those trials were performed in a limited setting and under ideal conditions of training, supervision and support to CHWs. To obtain a realistic picture for LMIC, Lee et al. (2014) studied inadequate illness recognition and lack of access to antibiotics ("stock-out") for young infants (<2 months). They studied whether frontline health workers can accurately diagnose possible bacterial infection (pBI), how available and affordable were antibiotics, and how often were antibiotics procured without a prescription? Their meta-analysis showed that clinical sign-based algorithms predicted bacterial infection in young infants with high sensitivity (87%, 95% CI 82%-91%) and lower specificity (62%, 95% CI 48%-75%), based on six studies and 14,254 cases. In comparison to physicians, frontline health workers diagnosed pBI in young infants with an average sensitivity of 82% (95% CI 76%-88%) and specificity of 69% (95% CI 54%-83%), based on eight studies and 11,857 cases. First-line injectable agents (ampicillin, gentamicin, and penicillin) had low variable availability in first-level health facilities in Africa and South Asia. Oral amoxicillin and cotrimoxazole were widely available at low cost in most regions. About 25% of pediatric antibiotic purchases in LMICs were obtained without a prescription (based on 11 studies, 95% CI 18%-34%), with lower rates among infants <1 year. In conclusion, trained frontline health workers may screen for pBI in young infants with relatively high sensitivity and lower specificity, while availability of first-line injectable antibiotics appears low in many health facilities in Africa and Asia.

Clearly, appropriate training and motivation of CHWs is one of the main prerequisites to a successful implementation of iCCM. Concerned that the effect of training of CHWs can rapidly wane, Rowe et al. (2012a,b) sought to determine if the performance of IMCI-trained health workers deteriorated over 3 years, studying two departments in Benin. Primary outcomes were the proportion of children under 5 years old with potentially life-threatening illnesses who received either recommended or adequate treatment, and among all children, an index of overall guideline adherence. They reviewed 9393 consultations and their surveys included 411 consultations performed by 105 health workers. For both data sources, performance trends were essentially flat for nearly all outcomes, suggesting no evidence that performance declined over 3 years after IMCI training. However, important performance gaps found immediately
after IMCI training persisted. Moreover, Rowe et al. (2012b) also sought to understand if shortening the training on Integrated Management of Childhood Illness guidelines reduced its effectiveness. The World Health Organization (which developed IMCI) recommends an 11-day course duration; however, shortening of the training would reduce a fixed cost in IMCI programmes. Rowe et al. (2012b) conducted a systematic review to compare IMCI’s effectiveness with standard training (duration ≥ 11 days) versus shortened training (5-10 days). Direct comparisons from three studies showed little difference between standard and shortened training. Indirect comparisons from 26 studies revealed that effect sizes for standard training versus no IMCI were greater than shortened training versus no IMCI; however, no result reached statistical significance. They concluded that standard IMCI training seemed more effective than shortened training, although the difference might be small.

More recently, two studies in Uganda examined CHWs and their performance and motivation within iCCM programmes. Bagonza et al. (2014) assessed factors influencing the performance of CHWs managing malaria, pneumonia and diarrhoea under the Integrated Community Case Management (iCCM) programme in Wakiso district, central Uganda. Performance was measured using composite scores based on the core activities of CHWs under the iCCM programme, which included treating children under five years, referring severely sick children including newborns, home visits, counseling caregivers on home care, record keeping and community sensitization. The overall level of good performance was 21.7%. Factors significantly associated with performance were: sex (females), community support, receiving feedback from health facilities, and having drugs in the previous three months. Only one in every five CHWs performed optimally under the iCCM programme, indicating that strategies to improve drug supply, community support and feedback provision from the formal health system are necessary to improve the performance of CHWs. Furthermore, Banek et al. (2015) focused on community case management of malaria and explored support, capacity and motivation of community medicine distributors in Uganda. They interviewed 100 community medicine distributors (CMDs), who had been involved in the HBMF programme in Tororo district, shortly before ICCM was adopted. They concluded that CMDs faced multiple challenges including high patient load, limited knowledge and supervision, lack of compensation, limited drugs and supplies, and unrealistic expectations of community members. At the time of the survey, over half of CMDs felt demotivated due to limited support from communities and the health system. The authors concluded that, if complex community interventions are the most realistic solution to improving access to primary health care, then greater attention to what motivates CHWs and ways to strengthen their support are required.

1.1.4. Low parental care-seeking behavior can limit the impact of IMCI and iCCM

Although the organization, training and performance of CHWs is certainly critical for the success of the iCCM strategy, parental care seeking behavior is also essential for achieving desired impacts. Herbert et al. (2012) hypothesized that limitations in care seeking for ill neonates and children contribute to high mortality rates. They reviewed care seeking for neonatal illnesses in LMICs, with particular attention to type of care sought. Of the 9,098 neonates in 22 studies who were ill or suspected to be ill, 4,320 caregivers sought some type of care, including care from a health facility (n=370) or provider (n=1,813). Care seeking ranged between 10% and 100% among caregivers with a median of 59%. Care seeking from a health care provider yielded a similar range and median, while care seeking at a health care facility ranged between 1% and 100%, with a median of 20%. The authors concluded that there
was a lack of consistency regarding illness, care-seeking, and care provider definitions, and a paucity of data regarding newborn care-seeking behaviors. They noted a clear need for representative data to describe care-seeking patterns in different geographic regions and better understand mechanisms to enhance care seeking during this vulnerable time period. In addition, Seidenberg et al. (2012) sought to assess how iCCM availability influenced care-seeking behavior in rural Zambia. In areas where two different iCCM approaches were implemented, they conducted baseline and post-study household surveys on healthcare-seeking practices among women who were caring for children ≤ 5 years in their homes. For children presenting with fever, there was an increase in care sought from CHWs and a decrease in care sought at formal health centers between baseline and post-study periods. For children with fast/difficulty breathing, an increase in care sought from CHWs was only noted in areas where CHWs were trained and supplied with amoxicillin to treat non-severe pneumonia. Their findings suggested that iCCM access influences local care-seeking practices and reduces workload at primary health centers.

1.1.5. Many challenges with national health policy formulation and resistance to IMCI persist

In addition to the above bottlenecks, further challenges remain with respect to national-level policy formulation and institutional support, planning and monitoring of IMCI and iCCM programs, and overcoming concerns and even resistance to IMCI programs. Rasanathan et al. (2014) reported findings from a cross-sectional survey on policy and implementation of iCCM in sub-Saharan Africa administered to technical officers in Ministries of Health and UNICEF offices in 2013 in 45 countries in sub-Saharan Africa. They focused on CHW profile, CHW activities and financing. Across 42 countries that responded, 35 reported implementing CCM for diarrhoea, 33 for malaria, 28 for pneumonia, 6 for neonatal sepsis, 31 for malnutrition and 28 for integrated CCM (which involves treatment of 3 conditions: diarrhoea, malaria and pneumonia). This represented a noted increase in uptake in comparison to 2010. In 27 countries, volunteers were providing CCM, compared to 14 countries with paid CHWs. User fees persisted for CCM in 6 countries and mark-ups on commodities in 10 countries. Most countries had a national policy, memo or written guidelines for CCM implementation for diarrhoea, malaria and pneumonia, with further 20 countries also having this for neonatal sepsis. It was favourable to note that most countries planned gradual expansion of CCM, but it was also very clear that many countries’ plans were heavily reliant on their development partners. A large group of countries had no plans for CCM for neonatal sepsis, and there was also considerable scope for expansion for newborn care. The key issues raised by countries include financing and sustainability (with development partners still providing most funding), gaps in data on CCM activities, and the persistence of user fees and mark-ups in several countries.

George et al. (2015) followed with a comprehensive iCCM policy analysis, focusing on its character, design and scale up in sub-Saharan Africa. They examined the policy processes underpinning iCCM through qualitative case study research in six purposively identified countries (Niger, Burkina Faso, Mali, Kenya, Malawi and Mozambique) and in the global context. They reviewed how policy analysis can inform how iCCM is framed; how it can be tailored for national health systems; and how accountability and learning for iCCM can be fostered. The authors concluded that adaptation to contextual realities may lead to unintended consequences not foreseen by technical or managerial expertise alone, and that further scaling up of iCCM requires understanding of the political accountabilities involved. Fostering of
ownership and learning how to improve policies and sustain programs are very important. Similarly, Rodríguez et al. (2015) explored how evidence-informed policymaking can be implemented in practice, studying country-level examples of use of evidence for iCCM policy in Niger, Kenya and Mozambique. The authors used Carol Weiss’ models of research utilization to further explain the use of evidence in these contexts. The authors used documentary review and in-depth stakeholder interviews as part of retrospective case studies in each study country. Findings indicate that all three countries used national monitoring data to identify the issue of children dying in the community prior to reaching health facilities, whereas international research evidence was used to identify policy options. Nevertheless, policymakers greatly valued local evidence and pilot projects proved critical in advancing iCCM. The authors suggested that, while evidence from research studies and other contexts can be critical to policy development, local evidence is often needed to answer key policymaker questions. They also emphasized that evidence may not be enough to overcome resistance if the policy is viewed as incompatible with national goals.

Indeed open resistance to IMCI implementation continues to be a challenge in some countries. Juma et al. (2015) examined policy resistance in Kenya, where iCCM policy development has been slow in comparison to other Sub-Saharan African countries. At the time of their study, the Government had just completed the Community Health Training Manual, which incorporated iCCM as a module, but this was the only formal expression of iCCM in Kenya. The authors found that technical considerations, most notably concerns about community health workers dispensing antibiotics, to be a key factor slowing iCCM policy development. In addition, there was an additional overlap with bureaucratic considerations, such as how the development of community health worker cadres may affect clinicians. Concerns were also voiced about how an integrated approach might affect vertically oriented programs. The promoting forces for iCCM in Kenya are international actors, whose advertising of Millennium Development Goals helped to get child survival onto the national policy agenda. Those actors are the active promoters of iCCM policy change, but international funders had not committed funding to scale-up iCCM policy, which is likely to constrain their influence on the ongoing iCCM policy debate in Kenya.

1.1.6. In order to be cost-effective and affordable, iCCM programs must be well utilized

In most survey-based evaluations of IMCI and iCCM programmes, the lack of financial resources is often quoted as a main challenge. Collins et al. (2014) attempted to cost integrated community case management (iCCM) programs in several countries. Data on coverage, utilization, and costs were collected as part of two sets of studies conducted between 2011 and 2013 for iCCM programs in seven sub-Saharan African countries (Cameroon, DR Congo, Malawi, Senegal, Sierra Leone, South Sudan and Zambia). The collected data were used to compare elements of program performance, costs per capita and costs per service, i.e. the key indicators of resource allocation and efficiency. Among the seven countries, iCCM utilization ranged from a total of 0.26 to 3.05 contacts per capita (children 2-59 months) per year for the diseases treated, representing a range of 2.7% to 36.7% of the expected numbers of cases. The total recurrent cost per treatment ranged from US$ 2.44 to US$ 13.71 for diarrhea; from US$ 2.17 to US$ 17.54 for malaria (excluding rapid diagnostic testing); and from US$ 1.70 to US$ 12.94 for pneumonia. In some of the country programs, the utilization of iCCM services was quite low and this, together with significant fixed costs, particularly for management and supervision, resulted in services being quite costly. The authors also noted that the differences
across the countries and programs imply that these results should be treated as indicative, rather than definitive. They concluded that, in order to be cost-effective and affordable, iCCM programs must be well utilized. Moreover, program management and supervision should be organized to minimize costs and ensure quality of care. There is a concern that iCCM programs cannot always be low-cost, particularly in small and remote villages where supervision and supply challenges are greater.

1.1.7. The role of the private sector in funding IMCI and ICCM requires greater consideration

The problems related to funding of IMCI and iCCM programmes raise questions on the possible role for private sector in supporting such programmes. Awor et al. (2014), conducted a systematic literature review of iCCM and the private sector in Africa, setting out to determine the extent to which the private sector has been utilized in providing integrated care for sick children under 5 years of age with common infections. The large majority of identified studies were related to malaria, mainly evaluating introduction of malaria drugs and/or diagnostics into the private sector. The authors concluded that the private sector is an important potential source of care for children in low-income countries, but also that little has been done to harness the potential of this sector in improving access to care for non-malaria-associated fever in children within the community. They suggest that iCCM programs should consider expanding their activities to include the private sector to achieve higher population coverage. This will necessitate the development of implementation research agenda for the private sector.

1.1.8. Recent evaluations of IMCI, IMNCI and iCCM programmes in LMIC settings show mixed results

In the past 3-4 years, several large-scale evaluations of IMCI and iCCM programs have been conducted and published. In a theme issue of the Journal of Global Health Diaz et al. (2014) provide an overview of the current scientific evidence for integrated community case management (iCCM) in Africa, summarizing the findings from the iCCM Evidence Symposium that took part in Accra, Ghana earlier in March 2014.

Within this context, Oliphant et al. (2014) presented the results of a multi-country analysis of routine data from iCCM programs in sub-Saharan Africa (SSA), examining 15 evaluations or studies of iCCM programs in SSA conducted between 2008 and 2013. All evaluations had information about the program; routine data on treatments, supervision, and stock-outs; and, where available, data from community health worker (CHW) surveys on supervision and stock-outs. The median percent of annual expected cases treated was 27% (1-74%) for total iCCM, 37% (1-80%) for malaria, 155% (7-552%) for pneumonia, and 27% (1-74%) for diarrhoea. Larger populations under-five targeted were negatively associated with treatment rates for fever, malaria, diarrhea, and total iCCM, while the ratio of CHWs per population was positively associated with diarrhoea treatment rates. Use of rapid diagnostic tests (RDTs) was negatively associated with treatment rates for pneumonia. Important conclusions of this analysis were that there was large variation in iCCM program performance in SSA. Treatment rates for diarrhoea were lower than expected across most programmes, while pneumonia was being over treated. Interestingly, treatment rates and percent of annual expected cases treated were equivalent
between programs with volunteer CHWs and programs with salaried CHWs (Oliphant et al., 2014).

Amouzou et al. (2014) assessed the impact of integrated community case management (iCCM) programs on child mortality in SSA. They identified eight recent studies and assessed those studies in terms of design, mortality measurement and results among children age 2-59 months. Six of the eight studies showed a higher decline in mortality among children 2-59 months in program areas compared to comparison areas, although this acceleration was statistically significant in only one study (with a decline of 76% larger in intervention than in comparison areas). They noted that evaluations of large scale iCCM programs in terms of mortality impact must ensure an appropriate study design, with required sample sizes and sufficient number of program and comparison districts to allow adequate attribution of impact. Failure to take those important issues into account will inevitably result in inconclusive mortality impact evaluations.

In a more recent thematic issue, published in The American Journal of Tropical Medicine and Hygiene, Hazel et al. (2016) summarized the results of independent evaluations of iCCM in Burkina Faso, Ethiopia, and Malawi, which were designed in 2009–2010, as a part of the Catalytic Initiative to Save a Million Lives. The three studies found that iCCM was not associated with accelerated mortality declines in children aged 2–59 months during the 2- to 4-year evaluation periods. The reasons for this lack of demonstrable effect were likely to differ across settings (Hazel et al., 2016). In Burkina Faso, iCCM implementation relied on community health worker (CHW) lay volunteers. The initial training was organized as a “cascade” in which representatives from districts were trained and then requested to organize subdistrict-level training sessions, with minimal support or supervision. In addition, the training included written materials, even though many of the CHWs were illiterate. Systems for ensuring the availability of drugs and reinforcing health worker performance were also not consistently in place at the time of training, and there were no systematic efforts to generate community demand for and utilization of iCCM services. As a result, the quality of iCCM service provision was poor, the services were grossly underutilized, and there was no improvement in intervention areas in the proportion of sick children who received correct treatment of their disease (Hazel et al., 2016; Munos et al., 2016).

However, Hazel et al. (2016) report that "...in both Malawi and Ethiopia iCCM was implemented more strongly and achieved important intermediate outputs. In both settings, government policies were in place to support full implementation of the strategy, and high numbers of paid community-level workers were well trained and initially well equipped. The percent of children receiving correct treatment from CHW for iCCM illnesses was moderately high in Ethiopia (78%) and lower in Malawi (63%), but it was at least as good as the care received in first-level health facilities.” However, in both Ethiopia and Malawi, there was no change in overall care seeking for iCCM illnesses and no impact on mortality. The potential effectiveness of iCCM was capped by low utilization. Care seeking rates simply did not increase over time. No matter how strong iCCM service provision may be, the strategy cannot save lives unless mothers and other caregivers take their children for care. They suggest that future iCCM programs must be designed with this in mind, and include strong, locally defined components designed to increase care seeking and utilization (Hazel et al., 2016).

Evaluations were also conducted in Benin (Rowe et al., 2011), Ethiopia (Tadesse et al., 2014) and Uganda (Mubiru et al., 2015). Rowe et al. (2011) evaluated the impact of a malaria-control project in Benin, that implemented IMCI and promoted insecticide-treated nets (ITNs), conducting a before-and-after intervention study with a non-randomized comparison group,
looking at both impact and process indicators. Early childhood mortality decreased in the intervention area after IMCI and ITN promotion, while ITN use increased similarly in both study areas, suggesting that the mortality impact of ITNs in the 2 areas might have canceled each other out. The authors conclude that the mortality reduction could have been primarily attributable to IMCI's effect on health care quality and care-seeking.

**Tadesse et al. (2014)** reported on utilization of iCCM services in three regions in Ethiopia after two years of implementation. They analyzed 60,452 encounters (58,341 [98.2%] for children 2-59 months of age and 2079 [1.8%] for children < 2 months of age) recorded in iCCM registration books from 2012 to 2013 in 622 randomly sampled health posts. Children 2-23 months constituted more than half (58.9%) of the total children treated, and about half of the registered infants < 2 months were not sick since some Health Extension Workers (HEWs) were recording well-infant visits. The authors concluded that the use of iCCM services, although increasing slowly, is low while and that recording healthy young infants in sick registers complicates tracking sick children.

**Lastly, Mubiru et al. (2015)** evaluated iCCM in Central Uganda between 2010 and 2012 through a pre-post quasi-experimental study, while 3 districts without iCCM served as controls. A two-stage household cluster survey at baseline (n = 1036 and 1042) and end line (n = 3890 and 3844) was done in the intervention and comparison groups, respectively, with changes in treatment coverage and timeliness assessed using difference in differences analysis. More than 5,500 Village Health Team members delivered nearly 2 million treatments to children under age five. Use of oral rehydration solution (ORS) and zinc treatment of diarrhoea increased in the intervention area, while there was a decrease in the comparison area. National stock-outs of amoxicillin led to a decrease in antibiotic treatment for ARI in both areas, with the decrease significantly greater in the comparison area. There was a greater increase in Artemisinin Combination Therapy treatment for fever in the intervention areas than in the comparison area, although this difference was not significant. In the intervention area, timeliness of treatments for fever and ARI increased significantly. Modelling based on LiST tool implied that an estimated 106 lives were saved in the intervention area, while 611 lives were lost in the comparison area as a result of worsened intervention coverage. The authors concluded that iCCM significantly increased treatment coverage for diarrhoea and fever, mitigated the effect of national stock outs of amoxicillin on ARI treatment, improved timeliness of treatments for fever and ARI and saved lives.

1.1.9. Research priorities for iCCM include optimal training, supervision, and motivation for CHWS and parental care-seeking behaviors

**Wazny et al. (2014)** led an expert-driven exercise that attempted to set global research priorities for integrated community case management (iCCM) using the CHNRI (Child Health and Nutrition Research Initiative) method. Research questions involving increasing the uptake of iCCM services, research questions concerning the motivation, retention, training and supervision of Community Health Workers (CHWs) and concerning adding additional responsibilities including counseling for infant and young child feeding (IYCF) and treatment of severe acute malnutrition (SAM) ranked highly. Operational research to determine optimal training, supervision and modes of motivation and retention for the CHW is vital for improving iCCM, globally, as is research to motivate caregivers to take advantage of iCCM services. The
authors also noted that experts working in-country or regionally in LMICs prioritized different research questions than those working in organization headquarters in HICs.

1.2. What is the present status of coverage and quality of treatment of sick children (including neonates) in high burden settings?

Since 1996 more than 100 countries have adopted IMCI. IMCI case management training (ICMT) is one of three IMCI components and training is usually residential over 11 consecutive days. Follow-up after ICMT is an essential part of training. Goga et al. (2011) wrote of global challenges with scale-up of the IMCI strategy, taking issues of scaling-up coverage and treatment quality into account. They used multi-country survey data to describe the barriers to rapid acceleration of ICMT and reviewed country perspectives on how to address these barriers, involving 27 countries from all six WHO regions and obtaining feedback from the selected national focal IMCI persons/programme officers, course directors/facilitators and IMCI trainees. The most common challenges to ICMT scale-up related to funding, in particular the high cost and long duration of the residential ICMT. Further barriers were poor literacy of health workers; differing opinions about the role of IMCI in improving child health; lack of political support; frequent changes in staff or rules at Ministries of Health; and lack of skilled facilitators.

The most common challenges to follow-up after ICMT were similar: lack of funding; insufficient funds for travelling or planning; inadequately trained or few supervisors; and inadequate job aids for follow-up. In several countries, some of these problems were being addressed through linking IMCI follow-up with routine supervisory visits. The authors recommended reviewing core competencies, followed by competency-driven shortened training duration or 'on the job' training, 'distance learning' or training using mobile phones. Moreover, linkages with other 'better-funded' programmes, such as HIV or malaria, should be considered to improve coverage and quality of IMCI programmes (Goga et al., 2011).

1.2.1. Indicators of coverage and quality of treatment are inadequate and require validation and improvement.

In addition to implementing surveys among the key stakeholders within IMCI programmes, there is also a growing need for better measurement tools and indicators of coverage and quality of treatment of IMCI programmes. Roberton et al. (2016) conducted a feasibility study of the indicator guide for monitoring and evaluating iCCM, which was published in 2014 by the iCCM Task Force. This "Indicator Guide for Monitoring and Evaluating iCCM" was designed a "menu" of recommended indicators with globally agreed definitions and methodology, to guide countries in developing robust iCCM monitoring systems. It was conceived as an evolving document that would incorporate collective experience and learning as iCCM programmes themselves evolve, with 18 routine monitoring indicators. The analyses highlighted challenges of using supervision checklists as a data source and that some of the recommended indicators need revising. The authors concluded that routine monitoring systems would be more feasible, effective and efficient if iCCM programmes focused on a smaller set of high-value indicators that are easy to measure, reliably interpreted and useful both for global
and national stakeholders and for frontline health workers themselves. Similarly to this effort, Mamo et al. (2014) assessed the monitoring and evaluation system for iCCM in Ethiopia, which also assessed global iCCM Task Force's benchmark indicators. The authors tried to determine the availability and feasibility of the iCCM benchmark indicators. They concluded that Ethiopia currently collects data to inform most (70%) of the iCCM benchmark indicators, and that a modest additional effort could boost this to 83%, while eight indicators (17%) are not available under the current system. Most benchmark indicators that track coordination and policy, human resources, service delivery and referral, supervision, and quality assurance are available through the routine monitoring systems or periodic surveys. Indicators for supply chain management are less available due to limited consumption data and a weak link with treatment data. Hardly any information is available on iCCM costs (Mamo et al., 2014).

An important sub-section of the recently awarded Bill and Melinda Gates Foundation grant on Maternal and Childhood Epidemiology Estimates (MCEE) is focused on validating the existing indicators and improving understanding of their value in tracking the coverage and assessing quality of treatment. Moreover, an international consortium of researchers, led by Johns Hopkins University scientists, attempt to develop and validate better indicators within their work on the MCEE grant (Munos, Campbell et al., personal communication, 2016). Their approach includes reviewing the standard household surveys and providing assessments whether they provide measures of intervention coverage or quality of intervention delivery. For facility-based interventions, the group plans to assess the feasibility of linking information from providers to household surveys, to obtain estimates of intervention coverage. Their initial results suggest that there is a greater need for continued improvement in the validity and reliability of coverage estimates provided by household surveys, then for the development and testing of new approaches for measuring coverage of facility-based interventions that are feasible for use at scale in low-income countries, and for interventions that are not delivered through health facilities. Do, Munos and Campbell (2016, personal communication) concluded that many measures of service coverage obtained from household surveys do not measure actual service delivery, resulting in a need for studies that link reports of where care is sought with assessments of the service environment in order to improve measurements.

At the moment, it seems that fewer than half of effective RMNCH interventions have a well-defined coverage measurements indicator in standard household surveys. Moreover, diarrhoea is usually seen as a disease for which correct diagnosis is much easier to establish than for other childhood illnesses, and indicators of intervention coverage (ORS and zinc) are also relatively straightforward. However, pneumonia and malaria represent much greater challenges.

Campbell et al. (2013) studied challenges in monitoring the proportion of young children with pneumonia who receive antibiotic treatment. Currently, progress in improving the global coverage of antibiotic treatment is monitored through large household surveys such as the Demographic and Health Surveys (DHS) and the Multiple Indicator Cluster Surveys (MICS), which estimate antibiotic treatment rates of pneumonia based on two-week recall of pneumonia by caregivers. Given that DHS and MICS survey tools identify children with reported symptoms of pneumonia, and because the prevalence of pneumonia over a two-week period in community settings is low, the majority of these children do not have true pneumonia. Because of this, the denominator of pneumonia cases for monitoring antibiotic treatment rates is not accurate. The authors suggested that the performance of survey tools could be improved by increasing the survey recall period, or by improving either overall discriminative power or specificity. However, even at a test specificity of 95% and a test sensitivity of 80%, the proportion of children with reported symptoms of pneumonia who truly have pneumonia is
only 22%, reflecting a very low positive predictive value of the survey tool. Thus, although DHS and MICS survey data on rates of care seeking for children with reported symptoms of pneumonia and other childhood illnesses remain valid and important, the authors remain very pessimistic about the ability of DHS and MICS surveys to provide valid estimates of antibiotic treatment rates in children with pneumonia.

Linked to those considerations, Hazir et al. (2013) conducted a prospective validation study in Pakistan and Bangladesh on measuring correct treatment of childhood pneumonia in urban and rural settings in Pakistan and Bangladesh. Caregivers of 950 children under 5 years with pneumonia and 980 with "no pneumonia" were identified in urban and rural settings and allocated for DHS/MICS questions 2 or 4 weeks later. Study physicians assigned a diagnosis of pneumonia as reference standard; the predictive ability of DHS/MICS questions and additional measurement tools to identify pneumonia versus non-pneumonia cases was evaluated. Results at both sites showed suboptimal discriminative power, with no difference between 2- or 4-week recall. The authors conclude that the current DHS/MICS questions and proposed new (video and pneumonia score) methods of identifying pneumonia based on maternal recall are both shown to discriminate poorly between pneumonia and children with cough. Reported antibiotic treatment rates among these children cannot be considered a valid proxy indicator of pneumonia treatment rates, implying that the data from DHS/MICS surveys should not be used for monitoring antibiotic treatment rates in children with pneumonia.

For malaria, Baiden et al. (2012) quoted WHO's recommendation for a test-based management of malaria across all transmission settings. Similarly to pneumonia case, the accuracy of rapid diagnostic test (RDT) will influence the performance and assessment of new guidelines. The authors conducted a study in rural Ghana to evaluate the performance of CareStart, which is a HRP-2 based RDT, using microscopy as reference and applied IMCI treatment guidelines: they restricted treatment to RDT-positive children and followed-up both RDT-positive (malaria) and RDT-negative (non-malaria) cases over 28 days in a sample of 436 children. Sensitivity and specificity of the RDT were 100.0% and 73.0%, respectively. Over the follow-up period, 18.5% RDT-negative children converted to positive, with 4.0% of them presenting with fever. Reports of unfavourable treatment outcomes by caregivers were higher among the non-malaria group than the malaria group. The RDT had good sensitivity and specificity, but a minority of children who will not receive treatment based on RDT results may develop clinical malaria within a short period in high transmission settings, which could undermine caregivers' and health workers' confidence in the new guidelines. The authors concluded that improving the quality of management of non-malarial febrile illnesses should be a priority in the era of test-based management of malaria.

A growing additional challenge for the IMCI and iCCM programmes is introducing newborn care, and very few studies exist on the related challenges. Nalwadda Kayemba et al. (2012) assessed the introduction of newborn care within iCCM programme in Uganda. Almost all Village Health Team (VHT) members reported that they refer sick newborns to facilities, and that they could identify at least three newborn danger signs. However, in this study they did not identify the most important clinical indicators of severe illness, so the extent of compliance with newborn referral and quality of care for newborns at facilities is not clear. Overall, iCCM is perceived as beneficial, but caregivers, VHTs, and health workers want to do more for sick babies at facilities and in communities. The authors concluded that additional research would be needed to assess the ability of VHTs to identify newborn danger signs, referral compliance, and quality of newborn treatment at facilities.
1.2.2. Increased attention and investment in global monitoring of IMCI, iCCM, and RMNCH interventions more generally are needed

In terms of measuring coverage of interventions critical for IMCI and iCCM programs, household surveys remain the primary data source of coverage indicators for children and women for most developing countries. Among the existing surveys, most of the information is generated by two global household survey programmes. One is the USAID-supported Demographic and Health Surveys (DHS), and the other one UNICEF-supported Multiple Indicator Cluster Surveys (MICS). Hancioglu et al. (2013) provided an overview of these two programmes, which provide the most valuable resource for tracking many Millennium Development Goal indicators. MICS and DHS collaborate closely and work through interagency processes to ensure that survey tools are harmonized and comparable as far as possible. They differ in the population covered and the reference periods used to measure coverage, which need to be considered when comparing estimates of reproductive, maternal, newborn, and child health indicators across countries and over time. Both surveys certainly have a remarkable value as a resource for global health research, but they also suffer from limitations and constraints. There are issues related to sampling and quality control, which will require continuing efforts to improve and refine survey methods and analytical techniques. Both DHS and MICS surveys also serve the needs of the Commission on Accountability for Women’s and Children's Health and they underlie the estimates of the indicators for the "Countdown to 2015" initiative, which is the leading effort in tracking progress for maternal, newborn, and child survival since 2005.

Requejo et al. (2013) studied the challenges and opportunities in the selection of coverage indicators for global monitoring through household surveys such as DHS and MICS. As the group closely involved with the "Countdown to 2015" monitoring effort, they underscore that global monitoring of intervention coverage is a cornerstone of international efforts to improve reproductive, maternal, newborn, and child health. They described how the generation of data for global monitoring involves five iterative steps: (i) development of standard indicator definitions and measurement approaches to ensure comparability across countries; (ii) collection of high-quality data at the country level; (iii) compilation of country data at the global level; (iv) organization of global databases; and (v) rounds of data quality checking. Because of this, they propose that regular and rigorous technical review processes are needed to maximize uptake. Such processes should involve high-level decision makers and experts familiar with indicator measurement. They should ensure that indicators used for global monitoring are selected on the basis of available evidence of intervention effectiveness, feasibility of measurement, and data availability as well as programmatic relevance. The authors suggested that more attention and continued investment should be directed to global monitoring, to support both the process of global database development and the selection of sets of coverage indicators to promote accountability. These indicators can drive policy and program development at the country and global level, and ultimately impact the health of women and children globally.

In the target year of the "Countdown to 2015", Requejo et al. (2015) summarized and evaluated the achievements in intervention coverage and strategies to best sustain, focus, and intensify efforts to achieve progress for this and future generations. The analyses implied unfinished business in achieving high, sustained, and equitable coverage of essential interventions. Some of the greatest coverage gaps are in family planning, interventions addressing newborn mortality, and case management of childhood diseases. Although inequities are pervasive, country successes in reaching of the poorest populations provide
lessons for other countries to follow. During the transition to the next set of global goals - the "Sustainable Development Goals" - the centrality of data to accountability and the importance of support of country capacity to collect and use high-quality data on intervention coverage and inequities for decision-making should increasingly come into focus.

Finally, projections up to 2035 have already been made based on the trends in coverage observed in the past two decades. Walker et al. (2013) analyzed historical trends and patterns in coverage of maternal, newborn, and child health interventions with proven effectiveness and used them to project rates of child and neonatal mortality in 2035 in 74 "Countdown to 2015" priority countries. The authors concluded that substantial reductions in child deaths are possible, but only if intensified efforts to achieve intervention coverage are implemented successfully within each of the "Countdown to 2015" countries.

1.2.3. Additional evidence is needed on quality of treatment across country contexts and study settings

Although quality of delivered interventions is an extremely important variable to consider in planning, monitoring and evaluating IMCI and iCCM programmes, very little is known about how the quality of treatment varies according to different contexts and study settings. In one study, Teferi et al. (2014) assessed the caseload and quality of IMNCI services in under-five clinics in Ethiopian health centres after iCCM was implemented. Their cross-sectional study used register review to assess IMNCI service use (before and after iCCM, in 2010 and 2012, respectively) and quality throughout the period in randomly selected health centers in three regions of the Integrated Family Health Program. Caseload of sick children at 28 health centers increased by 16% after iCCM implementation (21,443 vs. 24,882 children in 2010 and 2012, respectively). The consistency of IMNCI treatment with classification for pneumonia, diarrhea and malaria was low (78, 45, and 67%, respectively) compared to iCCM treatment (86, 80, and 91%, respectively). Health center caseload increased modestly after iCCM was introduced, but was lower than expected, even when combined with health post use from other studies. The authors concluded that demand strategy for sick children was in a need of review and that the quality of IMNCI needs improving even to bring it to the quality of iCCM at health posts, as measured by the same methods.

Moreover, Nanyonjo et al. (2015) studied the impact of an iCCM programme on uptake of appropriate diarrhoea and pneumonia treatments in Uganda. They measured the impact using a propensity score matching and conducted equity analysis. Their outcomes of interest were the uptake of appropriate treatment for children with a classification of pneumonia (cough and fast breathing) and/or diarrhea and the magnitude and distribution of socioeconomic status related inequality in use of iCCM. Their study showed that more children treated under iCCM received appropriate antibiotics for pneumonia (ATT = 34.7%, p < 0.001) and ORS for diarrhea (ATT = 41.2%, p < 0.001) compared to children not attending iCCM, but that no such increase was observed for children receiving ORS-zinc combination (ATT = -0.145, p < 0.05). There were no obvious inequalities in the uptake of appropriate treatment for pneumonia among the poorest and least poor (CCI = -0.070; SE = 0.083), and the use of iCCM for diarrhea was not significantly different among the poorest and least poor (CCI = -0.073; SE = 0.085). The authors concluded that iCCM was a potentially equitable strategy in the studied communities and that it significantly increased the uptake of appropriate antibiotic treatment for pneumonia and ORS for diarrhoea, but not the uptake of zinc for diarrhoea.
In conclusions, there are many concerns over the validity of indicators currently used for monitoring intervention coverage, that there is very little information of cost of IMCI and iCCM programmes and the quality of intervention delivery, and that the little information that is available gives many reasons for concern and suggests that there is still a lot to be done in order to optimize the ongoing programs.
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