Improving outcomes of childhood pneumonia in Kenya through pneumococcal vaccination and case management
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Chapter 7

Discussion
Discussion

7.1 Introduction

The studies presented in this thesis were designed to present the evidence base supporting current case management practices in low-income settings, to examine the potential of an integrated approach to improve use of recommended pneumonia case management practices among children admitted to hospital in Kenya and to estimate the likely cost effectiveness of introduction of pneumococcal conjugate vaccine in this country. The initial introduction in chapter one described the WHO case management strategy and showed that implementation of these guidelines have been successful in community case management, but success has been limited in hospital case management. This finding provided the justification for the additional studies presented in the thesis which explored how to improve pneumonia outcomes specifically amongst that group of children needing hospital care. Study III in particular set out to assess an integrated intervention aimed at improving implementation of multiple case management guidelines including pneumonia in different hospitals using a cluster RCT design. Study VI estimated the benefits and cost effectiveness of pneumococcal conjugate vaccination using Kenyan epidemiological and cost data and a decision analytic approach.

In the remaining part of this chapter we summarize the main findings from each study, discuss their implication for policy and current practice and highlight areas that might benefit from future research.

7.2 Pneumonia case management

The findings of our systematic review showed that despite recent efforts to standardize pneumonia definitions across studies there still exist significant challenges in summarizing data
on clinical features of pneumonia. Recent studies confirm the utility of signs promoted by WHO for diagnosing radiologic pneumonia. Fast breathing had the highest sensitivities (72%-94%) across studies and its specificity ranged from 38%-99%. Addition of clinical signs for diagnosing severe or very severe pneumonia has a variable effect on sensitivities and specificities. The classification of pneumonia severity also identifies children at higher risk of death, hypoxemia or bacteraemia supporting the continued use of the current severity classification. At least 80% of children with severe and very severe pneumonia within the reviewed studies were found to have shown clinical improvement at 48 hours following treatment with recommended antibiotics.

The findings of the systematic review support the utility of the current case management strategy in assessing children with ARI, classifying pneumonia severity and providing treatment appropriate to the degree of pneumonia severity. However, the review identified significant problems with current definitions of treatment failure and recommends studies be conducted to identify clinically appropriate definitions of treatment failure for each severity classification. Since our review was published some authors of the reviewed studies have reanalyzed their data to determine more appropriate definitions of treatment failure.

Separately, Hazir and colleagues have suggested improvements to the current WHO treatment failure definition. The proposed alternative therapy failure definition recommends that children with non-severe pneumonia be followed up for 72 instead of 48 hours and a change of antibiotics be considered on day 3 only in children showing signs of deterioration. The authors argue that this definition prevents unnecessary change in antibiotic treatment without causing any higher risks to children with severe pneumonia.
Concerning antibiotic treatment a recent Pakistani study has shown equivalence between home treatment with high-dose oral amoxicillin and inpatient treatment with parenteral ampicillin with 87 (8.6%) treatment failures in the hospitalized group and 77 (7.5%) in the ambulatory group (risk difference 1.1%; 95% CI -1.3 to 3.5) by day 6. A subsequent multicenter study designed to establish if the equivalency between oral amoxicillin and parenteral antibiotics reported in Pakistan is generalizable across countries showed that home-based therapy of severe pneumonia can be applied to a wide variety of settings both in Africa and Asia. It is important to note that this multicenter study was an observational study and there remains a need for more rigorously designed studies to establish the adequacy of amoxicillin for severe pneumonia in African children.

Other specific areas identified in our systematic review which remain unanswered and need to be addressed in future studies are adequacy of penicillin monotherapy, value of routine pulse oximetry as an aide to diagnosis, severity classification and treatment and use of broad spectrum antibiotic regimens for treatment of very severe pneumonia given its high case fatality.

7.3 Implementing guidelines to improve admission paediatric care

The multifaceted intervention delivered in our study improved guidelines use and quality of admission paediatric care across a set of common childhood conditions including pneumonia. Out of the 14 primary outcome measures representing different process of care, 5 were directly related to pneumonia case management and all these showed greater improvement in intervention compared to control hospitals following the 18 months intervention. The intervention achieved almost universal classification of pneumonia severity (95.1%) in intervention hospitals compared to a performance of 57% in control sites (adjusted difference
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Although studies suggest that simple dissemination of written guidelines has little impact on hospital care of children,18 our study confirms suggestions that the delivery of guidelines as a component of a multifaceted intervention significantly improved quality of care.2 18 Similar successes with multifaceted interventions have been reported in middle- and high-income countries. In Africa, consistent findings on guideline implementation have been documented for malaria case management,19 and severe malnutrition management.20 Additionally, we show that such improvements can be sustained in the face of high staff turnovers if intervention components include facilitation, feedback and support supervision suggesting that broader health system efforts are required to ensure successful adoption of clinical guidelines.

The ability to generalise these findings is however challenging as it is increasingly appreciated that complex interventions are difficult to standardize, and it might be necessary to redesign some of the intervention components to suit local contexts. It is also crucial to bear in mind that the results represent the effects of the entire package of components thus attempts at scaling up the intervention should therefore include all intervention components. The design and conduct of this study also provided an opportunity for parallel work that helped explain how the intervention achieved its effects. Such work included a careful description of the study context,21 how the
intervention was actually delivered, and challenges experienced by health workers expected to adopt new practices. This study thus contributes to an emerging body of literature on complex interventions with insights gained into ways to improve research approaches in the future.

7.4 Mortality in children admitted to hospital with pneumonia

The case fatality rate of pneumonia among children admitted to Kenyan hospitals was found to be relatively high with 5.9% of all pneumonia admissions to the nine hospitals resulting in death. The adjusted case fatality rates showed a four-fold variation across hospitals with case fatality rates as low as 3.1% in one hospital and rates of 13.2% in the hospital with highest mortality. These rates are consistent with those reported in other studies. The study demonstrates significant variations in mortality across hospitals possibly explained by the differences in hospital characteristics. Unfortunately, individual HIV data, a likely important risk factor contributing to such variation, were not available so any effect of possible differences in HIV prevalence across sites would only be captured by the hospital fixed effects parameters used to obtain the adjusted mortality rates.

The results of this study are, however, useful in healthcare decision making especially with the recent development of vaccines to prevent pneumonia as they indicate profound variation in mortality rates in contrast to the commonly made assumption, in burden of disease estimation, of homogeneity in mortality rates. Lastly, these findings highlight the limited research on contexts within which pneumonia mortality deaths occur and call for further studies to explain the marked variations in inpatient pneumonia case fatality rates reported in our analysis.
7.5 Economic burden of inpatient paediatric care

Inpatient treatment costs for common conditions including pneumonia vary according to the type of admitting facility. From the societal perspective tertiary referral facilities and faith-based hospitals tend to be more expensive compared to primary referral government facilities. For pneumonia admissions it was demonstrated that the higher treatment costs in these tertiary level and faith-based facilities was related to additional investigations done using the advanced diagnostic capacity available. Only basic investigations were conducted at first referral level.

Separately, the study showed that households of sick children make significant contributions towards these provider costs through the payment of user fees at government facilities and within faith-based and tertiary referral facilities the household contributions are even greater. High cost recovery had previously been reported in Kenyan hospitals especially in faith-based facilities. The data presented in this study are a significant addition to the limited literature describing disease specific treatment costs in different types of facilities in Kenya in particular and other developing countries. These estimates can provide unit costs for use in future cost effectiveness analysis of pneumonia interventions. The demonstration of the significant contribution made by households to provider treatment costs makes a case for an urgent implementation of the proposed National Social Health Insurance scheme currently being considered by the Kenyan government. The new insurance scheme should aim at universal coverage of Kenyan households as opposed to the current National Hospital Insurance Fund which mainly covers the small population in formal employment.

In the future formal full costing studies will improve the estimates of treatment costs and these studies should cover children attending outpatient facilities. These types of costing studies are
likely to provide more comprehensive information on the cost of paediatric illnesses that are much needed by decision makers.

7.6 Cost effectiveness of pneumococcal conjugate vaccination

The introduction of pneumococcal conjugate vaccine in Kenya is highly cost-effective using the current GDP for the country as a benchmark. This intervention also compares favorably with existing child health interventions,\textsuperscript{28} and essential HIV care,\textsuperscript{29} including ART in terms of its cost effectiveness. In addition, our analysis show that the cost effectiveness estimates would improve significantly if indirect effects of vaccination occur. In fact the vaccine has the potential of being cost saving under this scenario. Similar improvements in cost effectiveness have been reported following continuous routine use of PCV in the USA.\textsuperscript{30}

For health care policy makers in Kenya, vaccination of infants against pneumococcal disease is a priority deserving public funding and has the potential of providing savings to the healthcare provider through averting treatment costs. The study justifies the continued funding of PCV immunisation using government funds at the end of the donor supported funding period. These findings can be generalized to other low income countries with similar economic and epidemiological profiles.

In the future modelling the underlying transmission dynamics of pneumococci on populations will require data on pneumococcal carriage. Once these data become available in Kenya, or other low income settings, there will be a need to conduct similar analysis using dynamic disease transmission models to account for the complex disease transmission process.
7.7 Summary

In conclusion, pneumonia remains the leading cause of childhood deaths worldwide and low income countries account for a disproportionate burden of pneumonia deaths.\textsuperscript{31} Available child survival interventions including case management and vaccination against pneumonia have been shown to reduce pneumonia mortality.\textsuperscript{1,32} The studies presented in the thesis explore the evidence supporting current pneumonia case management practice and assess the potential for improving case management of severe forms of pneumonia among Kenyan children admitted to hospital while examining the likely costs and effectiveness of prevention resulting from introduction of the pneumococcal conjugate vaccination. The findings highlight the need to continually update pneumonia case management recommendations. In addition, the studies presented indicate that implementation of inpatient case management can be improved through applying a multifaceted approach to improving quality of care, and that pneumococcal vaccination is highly cost effective. Implementation of the interventions presented in this thesis need to be sustained and scaled up as one approach to reducing childhood pneumonia mortality.

REFERENCES


Effectiveness and efficiency of guideline dissemination and implementation strategies.


