VIEWPOINT

Smart Hospital Discharges to Address a Neglected Epidemic in Sepsis in Low- and Middle-Income Countries

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As many children die shortly after hospital discharge following in-hospital treatment for sepsis as during hospital admission.[1] Postdischarge mortality is an acute problem in low- and middle-income countries (LMIC), which are plagued by large numbers of socioeconomically disadvantaged children served with limited resources in congested and nonresilient health care systems. Postdischarge deaths are largely ignored despite concerted efforts to address child mortality worldwide during the United Nations (UN) Millennium Declaration era in which member states committed to decreasing mortality for those younger than 5 years by two-thirds between 1990 and 2015. Infectious diseases account for approximately half of childhood deaths, and sepsis is the final common pathway leading to most of these deaths. Although decreases in mortality were substantial, approximately 18 000 deaths still occur daily, mostly from preventable causes, with the major burden being in sub-Saharan Africa and southern Asia.

The heavy emphasis on child health, now in the era of the Sustainable Developmental Goals (SDG), is justified in that much of the burden of disease in children occurs in resource-poor areas and is owing to preventable conditions such as sepsis. We contend that the SDGs calling for an end to preventable child deaths requires leveraging gains made during the Millennium Declaration era. It is for this reason that the UN resolutions on sepsis have great implications for children.

The World Health Assembly (WHA), on unanimous recommendation of the executive board, adopted the resolution to improve, prevent, diagnose, and treat sepsis through a series of actions directed at developed and developing countries.[2] This resolution was adopted at the 70th WHA, on May 25, 2017, in Geneva, Switzerland. The resolution urges member states to implement measures to reduce the human and economic burden of sepsis, and requests the director-general to draw attention to the public health impact of sepsis. We believe that addressing postdischarge mortality is an essential component of care to achieve both the third SDG of improving child health and the UN resolution on sepsis in children.

The Burden of Postdischarge Mortality

Evidence suggests that in LMIC settings, postdischarge mortality may outnumber deaths during hospitalization. A systematic review of 13 studies conducted in LMICs showed a consistent trend of postdischarge mortality rates being similar to, or exceeding, in-hospital mortality in the months following discharge.[1] Some studies included children admitted for common infectious diseases including malaria, pneumonia, and diarrhea, whereas other studies examined all pediatric admissions. The most common risk factors for death after discharge included young age, malnutrition, HIV, pneumonia, as well as recent prior admissions.

These observations were reflected in a more recent study[3] from Uganda that found mortality among children aged 6 months to 5 years admitted with infection was 5% both in hospital and within 6 months of discharge. Approximately 90% of enrolled children met the International Consensus Conference definition of sepsis, indicating that postdischarge mortality must be considered a priority in improving sepsis outcomes.[4] This study also found that among those who died following discharge, two-thirds of deaths occurred outside of the formal health care system, usually at home. Therefore, efforts to improve outcomes must begin during hospitalization, rather than in the community because most of these patients do not reenter the health care system during this critical time. These data clearly point to the importance of appropriate follow-up care beyond the initial hospital admission, a facet of care that has received little attention in both high-income countries and LMICs.

Smart Discharges: A Precision Public Health Approach to Improve Outcomes

Interventions to decrease postdischarge mortality are ideally suited to precision public health. Precision public health can be defined as the use of precise data to improve the efficiency and effectiveness of public health interventions by focusing on populations with the highest probability of benefit. Furthermore, it also reduces the probability of unintentional harm among populations not likely to benefit. Dowel et al[5] argue that the use of precise data to direct policy and intervention is becoming more common in highly resourced countries; however, countries that could reap the most public health improvements are also the least likely to use such approaches.

The precision public health approach is ideally suited to improving postdischarge outcomes, provided that vulnerable children (ie, those at risk of postdischarge mortality) can be identified prior to discharge, and that effective interventions can be developed. Recent work in Uganda has shown this to be possible.[6] Such approaches are best described as *smart discharges*, and focus the limited resources toward the most vulnerable children. Smart discharges use risk prediction to identify at-risk children. Such tools could be stand-alone mobile applications or be integrated into existing electronic health platforms. At-risk children receive

comprehensive discharge planning along with interventions focused on reducing postdischarge mortality (eg, education on illness recognition, risk-reduction practices, and linkages for early routine follow-up). Using an evidence-based smart discharge approach, health facilities can be equipped to improve and streamline the discharge process.

Smart discharge protocols must be introduced during hospitalization. However, systems to ensure that discharged children are afforded necessary follow-up in their home communities following a severe episode of illness are rare, and hence deaths in the community following hospital discharge are common. Thus, an important component of the smart discharge is arrangement of appropriate community-level follow-up of high-risk children. This requires a change in the mindset of community-based care. Community health workers and low-level health centers (successfully established throughout many LMICs) must shift from exclusive focus on preventative health and early identification of the initial illness (up-referral) toward a holistic approach that also includes follow-up after severe illness (down-referral). A focus on community-level follow-up (as opposed to follow-up at discharging hospitals) not only acts to decrease congestion at district-level hospitals, but can also empower women to take a more active role in the health of their children by ensuring that transportation-related barriers are minimized, thus reducing the time and cost necessary to attend follow-up. Closing this referral gap ensures that children are able to receive follow-up in their communities. A recent proof-of-concept evaluation of smart discharge linked with a community referral program found that follow-up after discharge increased 3-fold, postdischarge hospital readmissions doubled, and there was a trend toward decreased mortality.[6]

Research Gaps and Way Forward

Postdischarge mortality is largely neglected in practice, research, and policy. Limited capability of health systems to track patients following discharge contributes to a general lack of recognition of the scale of mortality following discharge. The development of more integrated health systems that produce basic but high-quality electronic data are essential in developing both awareness among key stakeholders, as well as tracking progress during the implementation of interventions.

A key research gap is a deeper understanding on why children are at increased risk following discharge. Currently, the Childhood Acute Illness and Nutrition (CHAIN) network is seeking a better understanding of the biologic and socioeconomic mechanisms of postdischarge mortality.[7] Lack of awareness and a deeper understanding of causes and solutions have contributed to a general lethargy to adopt robust policies and guidelines to address this neglected cause of child mortality. Smart discharge offers a possibility to decrease death following discharge.

Addressing issues related to postdischarge mortality in the context of sepsis and acute infections, is an emerging opportunity for the global health community to make substantial gains in child mortality.

ARTICLE INFORMATION

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REFERENCES

1. Wiens MO, Pawluk S, Kissoon N, et al. Pediatric post-discharge mortality in resource poor countries: a systematic review. *PLoS One*. 2013;8(6):e66698.

2. Improving the prevention, diagnosis and clinical management of sepsis. Paper presented at: 70th annual meeting of the World Health Assembly; May 25, 2017; Geneva, Switzerland.

3. Wiens MO, Kumbakumba E, Larson CP, et al. Postdischarge mortality in children with acute infectious diseases: derivation of postdischarge mortality prediction models. *BMJ Open*. 2015;5(11):e009449.

4. Wiens MO, Larson CP, Kumbakumba E, et al. Application of sepsis definitions to pediatric patients admitted with suspected infections in Uganda. *Pediatr Crit Care Med*. 2016;17(5):400-405.

5. Dowell SF, Blazes D, Desmond-Hellmann S. Four steps to precision public health. *Nature*. 2016;540:189-191. doi:10.1038/540189a

6. Wiens MO, Kumbakumba E, Larson CP, et al. Scheduled follow-up referrals and simple prevention kits including counseling to improve post-discharge outcomes among children in Uganda: a proof of concept study. *Glob Health Sci Pract*. 2016;4(3):422-434.

7. The Childhood Acute Illness and Nutrition Network. http://www.chainnetwork.org/. Accessed November 9, 2017.