Background to the supplement

There is increasing awareness that the perennial problem of poor nutrition that has blighted the development of individuals and whole communities is not acceptable in a world where the potential resources are so plentiful, but not infinite. Personal, social, and national development is critically dependent upon good nutrition, and the health costs of not putting the knowledge we have into practice can be neither justified nor sustained. The effectiveness with which the threat of starvation can be ameliorated in emergency situations has raised the question as to why we are not able to address this unacceptably common problem routinely as an integral aspect of healthcare delivery. This more insidious, less obvious challenge is now recognized by the international community, which has responded to the clear evidence of the nature of the problem and the potential solutions through activities such as the agenda of the Scaling Up Nutrition (SUN) Movement [1]. This, together with a focus on the nutritional well-being of all mothers and children, seeks to address the challenge to society of both wasting and stunting through the mobilization of national capability and intersectoral collaboration to achieve sustained change that will widen opportunity at scale and improve the life of all.

For the 20th International Congress of Nutrition (ICN) held in Granada, Spain, in September 2013, the International Malnutrition Task Force (IMTF), of the International Union of Nutritional Sciences, in collaboration with the International Atomic Energy Agency (IAEA), organized a symposium on severe malnutrition in childhood in the context of the SUN agenda of the United Nations. In part the symposium was to celebrate the lifetime contributions of Professor John C. Waterlow to the scientific understanding of the natural history, pathophysiology, social determinants, and effective treatment and prevention of the condition. To this end, Dr. David Nabarro, a former student of John Waterlow and coordinator for the SUN Movement, was invited to present the first lecture named in Waterlow’s honor [2]. The symposium served to highlight the importance and activities of the SUN Movement, mark the progress that was being made, and indicate the necessary direction of travel.

In preparation for the ICN symposium, IMTF and IAEA had held two meetings to review progress, one for sub-Saharan Africa and the other for Asia. The meeting for sub-Saharan Africa was held in Ghana in December 2012, and the meeting for Asia was held in Thailand in May 2013. Each meeting provided the opportunity for national experience with SUN to be reported and discussion around how the academic and clinical communities could add their support and weight to the SUN Movement itself. Among the notable challenges for the SUN Movement are the need for capacity-building in professional nutritional capability and the establishment of effective intersectoral collaborations at the national level. Central to the aspirations of IMTF are those aspects of technical competence, professional training and practice, and operational research to improve service organization and delivery that are needed to bring about fundamental and sustained improvement in nutritional well-being at scale, most especially among mothers and children [2]. This Supplement consists of a selection of the papers that were presented at the ICN, together with papers prepared at the regional meetings in preparation for the ICN. Overall, the Supplement characterizes the challenges in understanding the science and
pathophysiological basis of a complex disease process, identifying and addressing the specific technical problems imposed in making solutions widely available and taking them to scale, and the contextual social and economic constraints to embedding and sustaining solutions to problems that are fundamental to life, but for which the solutions have to be integral to the fabric of society and the choices that people make about how their lives will be lived.

**Why focus on malnutrition?**

Malnutrition is easily overlooked, as it has often been seen as a statement of failure, the final common pathway that indicates society's inability to care for the most fundamental health and social needs of the most vulnerable. For most contexts, few if any data exist to indicate its magnitude or severity, and malnutrition does not feature in national statistics as an underlying cause in a large proportion of deaths [3]. The adoption of the Millennium Development Goals (MDGs) at the beginning of the century in 2000 marked a sea change in this concern by identifying the goals for health and development to be achieved by 2015 through the identification of specific targets in eight critical areas [4]. These represented major health and social concerns that severely constrain personal and social development, thereby carrying substantial economic cost. Three of the 8 MDGs (Goals 4, 5, and 6), 8 of the 18 targets, and 18 of the 48 indicators are directly related to health, and almost all are directly or indirectly related to nutrition. To achieve these goals, poorer countries pledged to improve policies and governance and increase accountability to their own citizens, and wealthy countries pledged to provide the resources. In particular, MDG 4 committed to addressing childhood mortality, much of which was a consequence of infection, and a substantial proportion of all deaths attributed to infection had poor nutrition as an associated or underlying cause. Although significant progress has been made in many parts of the world, it is estimated that there are still over 24 million children under 5 years of age who suffer from severe acute malnutrition (SAM); these children are more than 10 times more likely to die, with up to 2 million deaths annually [5]. In the longer term, malnutrition is associated with compromised development, especially neurocognitive development, as marked by stunting and inability of mothers to provide an environment supportive of good-quality child development. Therefore, for the longer term, improved maternal education will ameliorate intergenerational effects that should be progressively positive through improved child-care practices.

The Copenhagen consensus is provided by a group of the world's top economists setting priorities to answer the question: “What are the best ways of advancing global welfare, and particularly the welfare of developing countries, illustrated by supposing that an additional US$75 billion of resources were at their disposal over a 4-year initial period?” Among a series of proposals representing the world's most important challenges, for both 2008 and 2012, the panel identified nutrition-related interventions as the most cost-effective approaches to improve human well-being [6]. Over the past decade, several *Lancet* Series have reviewed the evidence for nutrition-related causes of ill health and effective interventions around maternal and infant well-being and childhood development, addressing nutritional problems that have consistently demonstrated the opportunity for effective interventions at scale. Thus the economic, health, and social arguments are strongly made and incontrovertible.

**Do we know what to do, and how to do it?**

From the 1950s to the 1980s, a number of specialized research centers around the world investigated many aspects of severe malnutrition in childhood, variously identified as marasmus, kwashiorkor, marasmic kwashiorkor, protein malnutrition, protein–energy malnutrition, stunting, wasting, edematous malnutrition, and severe acute malnutrition (SAM), without and with complications. The changing nomenclature reflects progress in understanding and the relative effectiveness of therapeutic interventions. The Tropical Metabolism Research Unit, established by the British Medical Research Council under the direction of John Waterlow in the mid-1950s, had as its mission the understanding of the pathophysiology of severe malnutrition, in order to better determine effective treatment for a condition that carried a case fatality rate as high as 50% [7, 8].

The two major insights into what is most needed derive from the authoritative work of Scrimshaw and colleagues on the intimate relationship between malnutrition and common infections, such as respiratory infections and diarrhea [9], and from the work led by Waterlow on the adaptations in physiological processes that enable survival in the face of a limited intake of food or unbalanced nutrient status associated with infection [8, 10]. At an early stage, Garrow and colleagues demonstrated the importance of potassium deficiency and associated magnesium deficiency, both as a cause of edema and a limiting factor for survival and recovery of tissue mass [11]. How cellular and protein metabolism accommodates the challenges of infection and poor nutrition had been the dominant ethos that determined approaches to care, to correct the obvious loss of protein from muscle and vital organs. The demonstration by Ashworth and colleagues that effective utilization of dietary protein and tissue
repletion were conditioned by the availability of energy completely transformed perceptions of the priorities for acute care and the opportunities for rapid weight gain [12]. This provided critical insights into how best to achieve metabolic control to enable cellular repair and to differentiate this aspect of care from the need for rapid weight gain—the basis for ordered and structured care. The more refined appreciation of how to achieve metabolic control by ensuring that the cellular metabolic machinery can be better enabled through the correction of deficiencies of micronutrients and trace elements and the understanding of the importance this might have for processes as fundamental as antioxidant protection were established by Jackson and Golden [13]. The potential impact on neurocognitive development of a short period of severe malnutrition compared with the magnitude of the cost of a background of adverse experience as marked by stunting was demonstrated by Grantham-McGregor and her team [14]. The opportunity to intervene and reverse the effects by helping mothers to better understand their children’s needs for intellectual stimulation and support set the opportunity for these interventions to be taken to scale, with substantial impact throughout life and to subsequent generations.

Translation into practice

This understanding set the basis for appreciating the problems related to inadequate food in terms of both its quantity and its quality, successful community care based on ready-to-use therapeutic foods (RUTFs) and personal parental responsibility, the secure management of complications and identification of which patients are best managed in the community and which in the hospital, and a structured approach to service delivery that cuts across food production and availability, social protection, and health. All of this understanding was in place by the turn of the century but still needed to be taken to scale in locations where the problems were most common and yet were inadequately addressed [15].

Based on the understanding generated by this basic clinical research in a small group of centers around the world, by the late 1970s case fatality rates could be reduced to less than 5%, with recovery of body weight within 6 to 8 weeks [13, 15, 16]. This enabled the publication by the World Health Organization (WHO) in 1981 of guidelines for the effective treatment of severe malnutrition in the hospital setting with low rates of mortality [17]. Unfortunately, this failed to have the impact that was hoped for on mortality [8, 18].

Prevention in the community and effective care to identify and manage those at risk had long been recognized as the most appropriate way to address the problem [19, 20]. UNICEF had developed a framework that recognized the interplay of the complex mix of social and hygienic factors that gave rise to the problem and was ultimately expressed through the final common pathway of poor growth, sickness, and malnutrition in young children. The value of screening using simple tools, such as mid-upper-arm circumference (MUAC), to identify those at risk and in need of care had been demonstrated [21], and appropriate approaches to home care that were fit for purpose in a range of different contexts had been explored in detail [22–24]. The basic scientific investigations had clarified the relative importance of perturbations in protein, energy, mineral, and micronutrient metabolism, and the complex interplay with infection and other biological and social stresses was well established [8, 13, 25]. What was lacking was a systematic approach that could be critically evaluated and improved through reflective practice.

Experience from emergency situations

In the late 1980s and 1990s, there were two particularly important developments that set the opportunity for treatment at scale. First, Daniel Lemmonier invited Briend and Golden to help apply the lessons learned in the clinical context to the challenge of emergency situations. The development of a product, RUTF, that achieved the therapeutic needs of supporting the special nutritional requirements of children for rapid weight gain represented the “magic bullet” that enabled effective quality care to be offered at scale [26, 27]. This, together with standard approaches to simple screening based on the use of MUAC to assess the degree of wasting, provided the opportunity for effective care that was a secure application in emergency situations [21].

In principle, extension of the same approach had wider application to less critical situations, leading to improved care for those identified as being at risk in the community and the development of community therapeutic care: community-based management of acute malnutrition (CMAM) [28–30]. The security of community care is based on four considerations: the ability to identify those with a problem at an early stage before complications supervene; the ability to offer a simple intervention based on a therapeutic food, the composition of which has been derived from clinical experience based on understanding of the pathophysiology; the opportunity to call on facility-based care when more complicated cases arise; and a community-based structure and system that has secure supply lines and is organized to deliver a sufficient standard of care on a secure basis.

The ability to make available sufficient food of good quality for effective treatment requires a secure
network for food distribution, and encouraging local food production for the formulation and production of RUTF enables backward linkages to agriculture, contributing to better social safety nets [31, 32]. Appreciation of the need for better-quality food and enriched diets has encouraged consideration of how best to manage moderate malnutrition, leading to better primary prevention through anticipation of the problem [33]. Together, these have encouraged the need for early recognition of poorly nourished children and action to incorporate addressing the problems early into routine health delivery systems as an integral part of child healthcare.

Facility-based management

The WHO guidelines for the treatment of complicated SAM in facilities were revised in 1999 [34]. It was offered as a 10-step process of structured care where the order in which aspects of care was carried out was as important as the individual steps themselves [35, 36]: gaining metabolic control while managing the life-threatening acute problems related to infection and disturbances of fluid and electrolyte balance, enabling rapid catch-up weight gain, preparation for discharge, and improving family care to ensure ongoing developmental progress and prevention of relapse. This formalization of inpatient care with a focus on detailed aspects needed to manage most sick children and encouragement of quality leadership and reflective practice was shown to be very efficacious when followed, even in resource-poor situations, but failed completely when inadequate attention was given to details, or the structures and systems for its execution were not put in place or sustained [37–39]. In the clinical context, the outpatient context, and community care, efficacy and impact could be demonstrated, which illustrated that failure of care was related to failure of the systems of health delivery and a workforce that was not appropriately trained and supported to sustain best practice [39].

The guidelines were reviewed in 2004, and the lack of evidence for a number of outstanding clinical challenges of importance was recognized, particularly the need to better understand care in people with HIV/AIDS and how the care of young infants less than 6 months of age might be addressed [40]. Earlier guidelines had been substantially based on expert clinical experience and opinion. A systematic review of the evidence for effective therapeutic care was commissioned [41], which, together with systematic reviews of specific areas of concern, provided the basis for a formal review of the guidelines, which have been recently published [42]. Everyone enjoys success, not least mothers and nurses, and given the opportunity, they have demonstrated their skill in learning lessons that are well taught to ensure that the understanding of basic science is effectively translated into usual practice.

Human resource and professional collaboration and service organization: Main constraints

Notwithstanding this progress, many severely malnourished children are not adequately detected by the health delivery system. Among those that are detected, there are still many potentially avoidable deaths, some of which can be attributed to inappropriate care. In the face of knowing what to do, we have not yet marshaled our capabilities to ensure that it is put into practice at scale in those contexts where the need is greatest. Weaknesses in health systems, inappropriate training of doctors and nurses, insufficient support from nutritionists, inadequate supervision, and lack of support staff all contribute to compromising the quality of care. In 2005, the International Union of Nutritional Sciences, with support from the International Pediatric Association (IPA), launched a global International Malnutrition Task Force [3]. The main objective was to ensure that an integrated system of prevention and treatment of malnutrition is actively supported as a fundamental aspect of childhood care and an integral part of all training programs. This drew upon the two main professional groups with responsibility for the nutritional well-being of children: pediatric health professionals and nutritionists. The commitment was formalized in 2010 by the IPA in the Johannesburg Resolution and by African nutritionists in the Nairobi Accord. The Johannesburg Resolution [43] states that:

» “Pediatricians and related health professionals should take responsibility for leadership in addressing the problem of severe malnutrition in all its forms, as it is a major cause of death and disability of children;”

» “IPA member societies should assure that all pediatricians and related health professionals have the identification and treatment of severe malnutrition as a core competency and be certified accordingly;”

» “National societies should examine the curriculum, training activities, and evaluation processes to ensure the inclusion of the identification and treatment of severe malnutrition as a core competency.”

The IMTF has developed and made available an eLearning course that is suitable for incorporation into the undergraduate curricula of doctors, nurses, nutritionists, and other health professionals to cover the identification, care, and management of malnourished children [44]. This learning has been found to be efficacious in improving knowledge and understanding. There still remains the challenge to ensure that this learning has impact at scale.
The way forward

Since the introduction of the MDGs, there has been great progress across many sectors. The introduction of the SUN Movement provides a framework for problem analysis at the national level and guidance on changes that offer the potential for sustained difference at scale. The different components of this complex problem have been ordered, and approaches to their resolution have been developed [45]. For the problems to be addressed at scale requires a complementarity of effort and approach toward a common purpose, with a national-level focus on coordination and the building of capability and capacity to address each facet of the problem.

In this Supplement, we have reports that illustrate the progress that has been, and is being, made across the three regions of Asia, sub-Saharan Africa, and Latin America [46–49]. The substantial problems presented by emergency humanitarian situations persist, despite the skill in managing them to good effect [50]. The opportunities for the development of therapeutic foods locally are illustrated [51], and the imperative of having in place secure systems to protect the quality of these products is emphasized [52]. Managing complex cases of severe malnutrition will always be a clinical challenge, but there has been important progress in the evidence to show the value of recognizing and treating silent infections [53] and the need to develop better approaches to the delineation of different causes of shock and their better management [54]. At the heart of all good-quality care is reflection and attention to the level of detail that quality assurance can facilitate [55]. Against the general principles that underlie prevention and care are the context-specific considerations that can only be made more widely available from sharing of experience and ownership of those experiences at the local level [56].

Together these papers represent an indication of the current situation, but they also present a statement from a community of health professionals committed to working together to address the scourge of childhood malnutrition.

References

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