Part 1
Introduction

CHAPTER 1

Working Clinically in Resource-Limited Settings

Ronald Pust[1], Peter S. Azzopardi[2,3], and Shreya Patel[4]
[1]University of Arizona, Tucson, AZ, USA
[2]Royal Children's Hospital, Murdoch Children's Research Institute, and University of Melbourne, Melbourne, Australia
[3]Wardliparingga Aboriginal Research Unit, South Australian Health and Medical Research Institute, Adelaide, Australia
[4]Massachusetts General Hospital, and Harvard Medical School, Boston, MA, USA

Key learning objectives

- Discuss the similarities and differences among clinical roles in resource-rich countries and resource-limited settings.
- Review the evidence-based rationale for relying on patient demographics, history, and physical examination in any clinical setting, whether or not resource-constrained.
- Cite additional resources for acquiring the skills and knowledge for working effectively in resource-limited settings, including books, websites, and courses emanating from and/or designed for low- and middle-income countries.

Abstract

Learning to provide quality medical care in a resource-limited setting can be both challenging and rewarding if the clinician is prepared with global health knowledge, problem-solving skills, and cultural humility. Although clinical resources may be limited in global health practice, the underlying bases of diagnosis and therapy are not fundamentally altered by resource level. However, the application of those principles in a resource-limited setting differs significantly from typical practice in resource-rich countries, where patient demography, cultural contexts, disease epidemiology, and cost-effectiveness may be viewed differently by clinicians. This chapter concentrates on these differences and the similarities in underlying clinical principles, illustrating several implications for a clinician's role in resource-limited settings. It concludes with an extensive list of resources, including international clinical reference books that can facilitate practice in sustainable, equitable partnerships with host-nation clinicians and mentors.

Key words: global health, international health, cross-cultural, advocacy, evidence-based medicine, syndromic diagnosis, resource-limited settings, cost-containment, clinical decision-making, medical ethics, case studies, bibliographies

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Introduction

Working as a healthcare professional in resource-limited settings is both a rewarding and an enriching experience (Pust, 1984a; Azzopardi & Gray, 2010). Professionally, providing clinical care in the context of limited resources nurtures development of clinical diagnostic and therapeutic skills, which are widely valued in any setting (Palfrey, 2011). Working in diverse sociocultural settings promotes the development of communication skills, confidence, flexibility, adaptability, and resilience (Parker *et al*., 2011). Global health also fosters a more sound understanding of health, well-being, and their complex determinants (Ventres & Wilson, 1995).

A goal of healthcare professionals working in a resource-limited setting is to promote attitudes and approaches that foster respectful and collaborative relationships within each uniquely diverse culture, community, and health system (Nelson *et al*., 2012). This chapter begins by considering the role and responsibilities of visiting health professionals and the importance of understanding local context, capacity, and priorities. We introduce broad concepts of providing cross-cultural clinical care to build on a foundation of existing clinical skills. The underlying premise is that an accurate medical history and physical examination, judicious use of investigations, coupled with knowledge of local prevalence of diseases and health resources, will enable clinicians to provide good clinical care. We illustrate syndromic approaches to diagnosis using a case study of a child with fever. The chapter concludes with a comprehensive list of books and websites that may serve as additional resources.

Orientating to the health system

Resource-limited settings are largely characterized by high burdens of disease and injury, economic disadvantage, political turmoil, natural disaster, racial and gender-based discrimination, or marked socioeconomic disparity. "Developing country" is an alternate term; however, it sometimes implies a Western concept of development, viewed as derogatory by some. The World Bank utilizes terminology based on gross per-capita income level (e.g., low- or middle-income country, or LMIC). Over the past 15 years, the term "international health" has increasingly become "global health," the latter term encompassing an interdisciplinary cooperative approach to health and its determinants (Koplan *et al*., 2009).

Perhaps what these terms do not reflect is the great heterogeneity both within and across these settings; consequently, experience in one setting may not necessarily translate to another. Most importantly, communities that have limited material resources are likely to be wealthy in terms of cultural, communal, and environmental resources (Marsh *et al*., 2004).

The determinants of health and well-being are complex, and many health-related programs in resource-limited settings focus on health outcomes or disease, often distinct from promoting health and wellness. Focusing on disease is a pragmatic response to the combination of overwhelming disease burden and limited resources (Jamison *et al*., 2006). However, the opportunity that each clinical interaction provides to address broader health and well-being should be maximized whenever possible, especially as people living in resource-limited settings often experience significant barriers in accessing healthcare. Initiatives such as the Integrated Management of Childhood Illness (IMCI) include this strategy of making the most of each clinical encounter.

Health systems, as described in Chapter 2, include organizations, policies, resources, and people whose primary purpose is to improve health (WHO, 2010). Global health systems are growing increasingly complex. Every country, as well as different global health stakeholders, may have differing interests and influences (Frenk & Moon, 2013). While working in resource-limited settings, understanding the health system is paramount. Figure 1.1 highlights the major tiers of health service, using the example of the World Health Organization (WHO) program for Integrated Management of Adolescent and Adult Illness (IMAI). While community-based health centers usually provide the majority of initial primary care for patients, district and regional hospitals provide referral services and commonly host visiting healthcare clinicians.

Clinicians should not feel overly daunted at the prospect of working in a resource-limited setting. The language of medicine is universal, and basic scientific and clinical methods remain relatively unaltered by resource level. Increasing globalization and urbanization may result in your host country not feeling as "foreign." Additionally, you may be surprised with the familiarity of the health conditions you encounter: while communicable or infectious diseases have traditionally been more common in LMICs, non-communicable diseases (e.g., mental disorder, cardiovascular disease, diabetes, chronic respiratory disease and cancer) have increasingly "gone global" and now account for more premature death and disability than infectious diseases in nearly every nation. There are, however, some important considerations that can help clinicians prepare for working in resource-limited settings, outlined in Table 1.1. It is these considerations that form the focus of the remainder of this chapter.

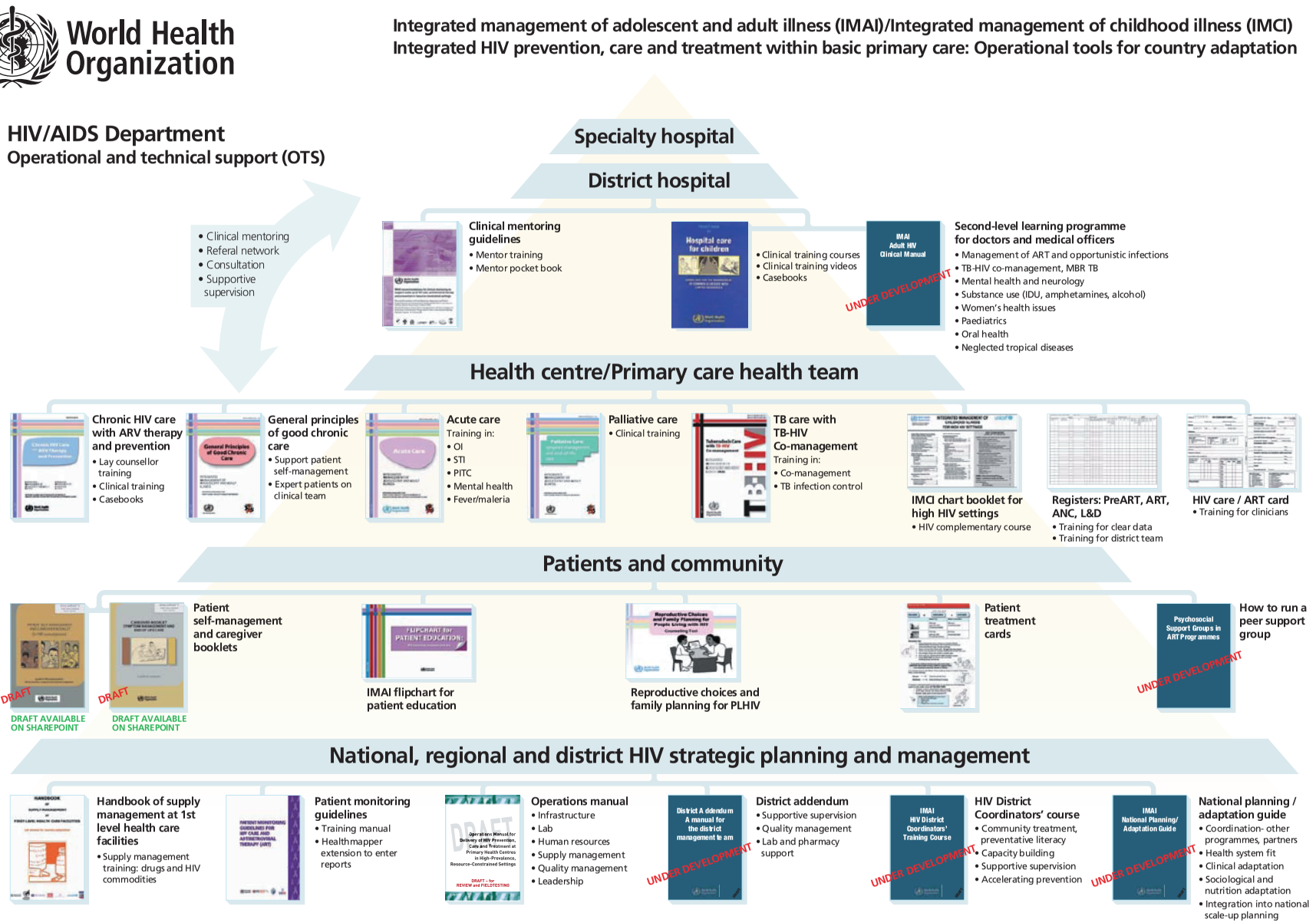

Figure 1.1 Tiers of the typical healthcare system, with the corresponding WHO guidelines for each level of care. The district hospital plays a key role in terms of clinical mentoring, supporting a referral network, consultations, and supportive supervision. *Source*: World Health Organization. Reproduced with permission of the World Health Organization.

Table 1.1 Some key considerations relating to clinical practice in resource-limited settings.

Clinical care

- With fewer resources, clinicians and patients often have fewer options, and even these limited options may not be available with the immediacy expected or required.
- Clinical encounters will include both the familiar and esoteric with regard to diseases, treatment modalities, and medications. For example, Chagas disease or tuberculosis may be extremely common, zinc might be included as treatment of diarrhea, and salbutamol tablets may be used rather than inhalers.

Patient populations

- Culturally, clinicians will find differences in language, family, and social norms. For example, elders are often highly regarded, and sometimes families will shelter them from devastating diagnoses. Or, it may be inappropriate for male healthcare providers to treat female patients.
- LMICs are often at different stages along the demographic transition with some still experiencing high birth and death rates, resulting in a young mobile population.
- Even within a given setting, there may be major differences in health and health resources depending on wealth or class, especially in urbanized settings, leading to vast disparities in outcomes.
- There are often differing expectations of health and wellness; patients may be incredibly trusting and unquestioning of decisions from healthcare professionals.
- The role of spirituality and health are often interrelated, with traditional healers playing key, revered roles in the community.
- Patients may have had little prior contact with the healthcare system. Barriers to healthcare access may be complex; geographic isolation, personal financial resources, health illiteracy, competing commitments, permission, and fear are common.

Laws and regulations

- In some settings, for example, it may be illegal to provide termination of pregnancy. While personal views among clinicians may differ, remember that as a guest, breaching local laws is likely to result in greater harm than good for the patient, the health service, colleagues, and oneself.

National systems and resources

- Healthcare systems may be structured differently, and perhaps more or less equitably, than in high-income countries. Often the costs covered by the patient or system will be very different than in resource-rich countries. For example, in LMICs, the government may provide all antiretroviral therapy (ART), but a patient may have to pay out of pocket for an intravenous kit and fluids.
- Health services may be delivered by a myriad of health and social service agencies – government, non-governmental, and faith-based organizations – with differing levels of integration.
- "Task-shifting/-sharing" is increasingly employed to address health-workforce shortages and involves training individuals to provide specialized healthcare usually outside their typical role. For example, in a setting where doctors are limited, the ministry of health may train and support nurses to staff primary care clinics or to prescribe and dispense ARTs. Community health workers, who are usually community members with basic health training, are another key player in resource-limited settings; they can facilitate health service access, provide care, and serve as links between health services and the community.

The clinician's role working in a resource-limited setting

Given the heterogeneity of resource-limited settings and diversity of clinical roles, it is impossible to provide comprehensive guidance to working in these settings. However, the principles that follow may assist the clinician in developing a clinical approach that is most effective.

Understanding your clinical role, capacity, privilege, and limitations

Having the host clearly define your clinical role will help delineate how best to contribute and learn. Ideally, the role should be defined by the host before you commence and be continuously reviewed and refined during your stay.

Working in a resource-limited setting will invariably require stepping outside comfort zones, both within and beyond one's specialty. However, it is essential to practice within your skills and training: "If you wouldn't back home, don't do it abroad" (Crump & Sugarman, 2010; Parker *et al.*, 2011). It is critical to be honest with oneself, colleagues and patients regarding clinical skills, capabilities, and limitations. Expect to not have all the answers, and be prepared that outcomes of clinical care may not always be good, even if it is an area of expertise. Identify a mentor, distinguish personal and professional limits, and recognize when and how to take care of yourself (see Chapter 4).

As a visiting clinician, one will likely be treated with a great deal of respect by the host institution. The visiting clinician's opinions may be accepted over those of local, more experienced clinicians, so facilitating and respecting the input of local clinicians is paramount. Local staff may be reluctant to question one's decisions or behavior. In general, open inquiring communication is best for patients and the healthcare team. Additionally, it is also important to consider personal behaviors outside the clinical environment, to be respectful of local cultures and norms, and to preserve a professional reputation and collegial relationships.

Role as an educator

Health knowledge is an important determinant of health outcomes for populations in resource-limited settings. It follows that knowledge exchange is an important component of working in global health. Every stage of medicine involves the opportunity to both teach and learn from patients and colleagues, and this exchange is often enriched in new settings. Evidence, guidelines, and approaches that are effective in the home setting may not be appropriate for the resource-limited working environment (Davey, 2001). Consult local clinicians and professionals about their professional development needs and how you might help address those needs.

Flexibility in teaching style becomes particularly important in the diverse settings of resource-limited settings. For example, busy crowded wards may or may not be the appropriate place for bedside teaching based on both logistics and cultural norms. However, case discussions conducted in a non-threatening and supportive environment can provide a powerful vehicle for education and professional development. Providing a discharge summary to the nurse at the clinic and to the admitting officer can improve patient care and follow-up and can also be educational.

In addition to opportunities to teach, working in a resource-limited setting provides an opportunity to learn (Ventres & Wilson, 1995). Professional development, however, should not be at the expense of local staff and patients (Parker *et al.*, 2011).

Role as an advocate

Medical work in LMICs can frequently be witness to human injustice (Foege, 1998), which may include discrimination and abuse, political turmoil in conflict situations, or famine and extreme poverty. Clinicians have an opportunity to bear witness (or *témoignage*, as described by Médecins Sans Frontières) and to raise awareness around important health injustices. Open discussions with the hosts and patients are vital in pursuing advocacy. Yet it is essential not to impose one's own values and expectations. Be realistic around what can be achieved, and consider the implications of advocacy, both in its success and failure.

Role as a clinician

The role as a clinician is to provide healthcare, and this may seem like second nature to experienced clinicians. However, there are some important considerations in working in a cross-cultural setting. Working closely with an interpreter, community health worker, or local colleague can help one translate both language and culture. For example, there may be specific protocols for addressing community elders or greeting patients (e.g., shaking hands may be impolite). It may be disrespectful in some cultures to ask about deceased children, "bad luck" to ask in detail about pregnancy, or improper to take a sexual health history from a patient of the opposite gender. Remember, many patients in resource-limited settings have had limited contact with the Western healthcare system and may be unfamiliar or overwhelmed by what might be considered a "routine" question. In Sara's case for example (Boxes 1.1–1.3), there may be important reasons why her first contact with the health systems was delayed for two days. Reasons may include financial, alternate care seeking (Hill *et al.*, 2003), or fear of the health system. Perhaps there is no reason at all, and detailed questioning may be misinterpreted as placing blame. Indeed, many of the determinants of health and health-seeking behavior in resource-limited settings are shaped by complex factors, and many are beyond the patient's control.

There may also be important considerations in conducting a physical examination, especially in patients of the opposite gender. Importantly, if a sociocultural protocol is breached, be gracious, apologetic, and never defensive (Shah & Wu, 2008).

Understand local context, priorities, capacity, and opportunities

Orienting to the country in which one will be working is fundamental to providing healthcare that is effective and efficient. Key contextual factors include the structure of the health system; local diseases (Lim *et al.*, 2013) and treatment patterns; basic cultural and historical facts; and health indicators for that country, such as the infant mortality rate and maternal mortality ratio (which are indicative of the country's overall level of health and stage of epidemiological and demographic transition). In Sara's case, an understanding of the local epidemiology and seasonal prevalence of malaria, for example, is critical to appreciating the potential causes of her fever.

There are some aspects of working in resource-limited settings that can be particularly discomforting or overwhelming for clinicians. Health services can be significantly over-stretched by both volume of patients and severity of disease. Common therapies, such as oxygen, may be either very limited or unavailable. Oftentimes, clinicians may need to decide which patients are most needing of this precious resource. These decisions are difficult and should involve local staff. A pragmatic approach is to focus on what can be done (Pust, 1984b) and

Box 1.1 Case study: Sara from Kenya – health center to district hospital

This actual case of "Sara" from Kenya (for whom we are using a pseudonym and a non-patient photo [Figure 1.2]) is divided into three stages in her care. At the end of each stage, discuss how Sara's care should be managed, based on the principles in this chapter.

Sara is a 3-year-old girl from a remote district of Kenya at an elevation of 1680 m (5500 feet). Because of 2 days of fever and malaise, her parents took her to the local health center. Her WHO "Road to Health" card documented full immunization and steady growth tracking the 50th percentile. The nurse at the health center found Sara to have fever and "hard breathing." A malaria blood smear was performed and reported "positive." Therefore, the nurse gave Sara antimalarials, and she was taken home. Later that day, her breathing became deep, rapid, and somewhat labored, so her father took her to the district hospital, 30 km from home.

At the hospital, Sara was assessed by the clinical officer, who found her very unwell with decreased consciousness and fast breathing. Her vital signs showed tachycardia (154 beats per minute), tachypnea (72 breaths per minute), and fever (39°C).

What are the possible causes of Sara's presentation? Does the season and elevation contribute to the initial assessment (pre-test probability)? What should be done next?

Figure 1.2 "Sara" is brought by her parents to the local health center, where she is found to be febrile and breathing fast. *Source*: Science Photo Library.

Box 1.2 Case study: clinical assessment of Sara at the district hospital

Sara's blood smear was reported as "3+ *P. falciparum* malaria." Her hemoglobin was 6.1 g/dL, and her blood glucose was normal (5 mmol/L = 90 mg/dL). The clinical officer made two diagnoses: (1) complicated malaria and (2) severe pneumonia. Sara was admitted and given oxygen plus intravenous quinine (for malaria), ampicillin, and gentamicin. On evening ward rounds, Sara was reviewed by the doctor, who confirmed these vital signs but found Sara unresponsive. Her neck was not stiff. Her palms and tongue were slightly pale. She had no cough or chest retraction, despite her respiratory rate of 72. Her abdominal examination was normal, other than a barely palpable liver and spleen. Her last urine output was approximately 8 hours earlier.

What is your assessment at this point? How many diseases does Sara have?

What if the assessment is incorrect (false-positive or false-negative diagnosis)? What small device might help differentiate between malaria and pneumonia? Should treatment for both malaria and pneumonia be continued? Are more treatment(s) necessary? If so, for what other diagnoses?

do that well. Some patients will present with diseases that, unfortunately, cannot be treated with local resources (e.g., a newborn with spina bifida). However, there is still likely much that can be done to improve health outcome. Explaining the disease to the parents or the fact that this condition has been seen before can help foster acceptance (in some cultures, congenital disease is associated with an evil curse or shame). Palliation may involve dressings and antibiotics for infection. There is also an opportunity for education and health promotion for future pregnancies.

Box 1.3 Case study: management of Sara's complex illness

The doctor's assessment was severe *P. falciparum* malaria. The two complications appeared to be cerebral malaria and metabolic acidosis, both of which are common in children with falciparum malaria, the predominant species in Africa.

The doctor continued treatment for severe malaria with intravenous quinine (first-line treatment with intravenous artesunate was not available). Special attention was paid to monitoring and preventing hypoglycemia (which would be undetectable in an unconscious child like Sara), fluid overload, and hyponatremia.

The doctor was not convinced that Sara had pneumonia; she assessed the respiratory rate and depth to be due to compensatory respiratory alkalosis in response to the severe metabolic acidosis brought about by complicated malaria.

Nevertheless, she did not stop the intravenous ampicillin and gentamicin or oxygen therapy. This was for two reasons.

1. In some cases it can be very difficult to clinically distinguish pneumonia from severe malaria.
2. Sara was by now comatose, presumably from cerebral malaria. However, there is some chance that her altered mental status (Area 4 in Figure 1.5) could be due to concurrent meningitis. No lumbar puncture had been done in the outpatient department prior to starting ampicillin and gentamicin; therefore, it would now be difficult to completely exclude bacterial meningitis, a rapidly devastating disease.

Should a lumbar puncture have been performed on Sara? What are the potential outcomes of "missing" meningitis (a false negative)? What about treating with effective drugs (ampicillin and gentamicin) without first having evidence of meningitis (a potentially false-positive diagnosis)? Does it make any difference?

The next day, Sara's vital signs became normal, but she was still unconscious and her malaria smear remained 2+ positive. The same treatment continued. By day three, Sara was clinically normal, sitting up, and eating well.

What can be learned from Sara's case? What can be learned about working clinically in a resource-limited setting? In what ways is it different from working in a resource-rich setting? How is it similar?

It is important not to focus on the deficits. Instead, take a strengths-based approach (Marsh *et al.*, 2004; Pust, 2007). You may well be surprised to learn the diversity of resources and skills available within your health service. Local health staff in a resource-limited setting are often very skilled at providing care across specialties, such as anesthesia, obstetrics, minor surgery, and neonatal care. There may also be other services within the health system that can complement what the health facility can provide.

Understanding referral pathways, which may be quite complex and/or costly for a patient, can assist in providing more comprehensive healthcare. This is especially critical in resource-limited settings as many patients will have had limited contact with the health system, and each clinical encounter provides the opportunity for health education, promotion, and prevention.

Clinical diagnosis and case management in resource-limited settings

The scientific bases (Sackett, 1992; Straus *et al.*, 2005; Herrle *et al.*, 2011) and goals of clinical care remain largely unchanged by resource level. Common principles of good clinical care anywhere include efficient (Palfrey, 2011; Dhaliwal & Detsky, 2013) and evidence-based stewardship in the allocation of resources (McGee, 2012). In practice, resources are limited or constrained in almost all settings. However, it is often when clinicians from resource-rich settings practice in resource-limited settings that they truly learn the value and effectiveness of the science underlying diagnosis and treatment. To illustrate this, consider the questions in the case of Sara (Boxes 1.1–1.3).

Diagnosis on the basis of your patient's demographics, symptoms, and signs

Patient demographics and the presence or absence of findings on history and physical examination are just as much "tests" as laboratory investigations (Straus *et al.*, 2005; McGee, 2012). In the case example, Sara's history of fever and malaise are **sensitive** tests for a host of diseases. However, neither fever nor malaise is **specific** for any disease; if based on these findings alone, the diagnosis will likely be imprecise or incorrect. Figure 1.3 reinforces the need for other findings – those with higher specificity and predictive value – if we are to have higher diagnostic accuracy.

Three principles can be used to increase the diagnostic accuracy of clinical findings:

1. interpreting clinical findings in the context of the local epidemiology;
2. considering "clusters" of clinical findings or syndromes;
3. using laboratory investigations judiciously.

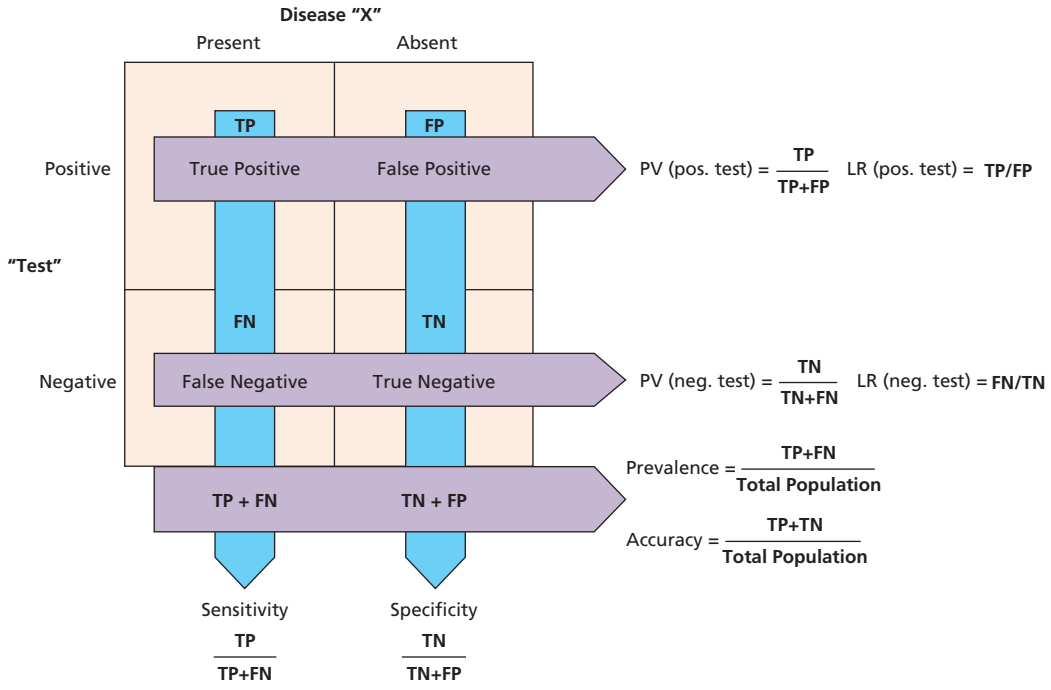

Figure 1.3 Two-by-two table on the relationship between test and disease: the basic concepts of clinical diagnosis in all settings. TP, true positive; TN, true negative; FP, false positive; FN, false negative; PV, predictive value. Likelihood ratio (LR) can also be computed from any such two-way table: LR of a positive test or finding = TP/FP; LR of a negative test = FN/TN. A positive high-specificity test tends to "rule in" the suspected diagnosis (remembered as SpIn+). A negative high-sensitivity test tends to "rule out" the suspected diagnosis (remembered as SnOut–).

Interpreting clinical findings in the context of the local epidemiology

The classic triad of time, place, and person (i.e., patient demographics) determine to a great extent the relative prevalence of disease. The fact that Sara was a child and from a malaria-prevalent area increased the risk that she had clinical malaria (Taylor *et al.*, 2010). These epidemiological findings must be considered when estimating her pre-test probability of any specific disease, such as malaria (Richardson, 1999). Additional diagnostic tools are then used to generate a **likelihood ratio**, which is the ratio of true positives to false positives of any clinical finding ("test") for the disease being considered, in this case malaria. The Fagan nomogram (Figure 1.4), or the equivalent in hand-held software, can be used to calculate the post-test probability of that disease. The red and green lines in Figure 1.4 demonstrate these concepts. While experienced clinicians are not formally completing this analysis with each patient test, the foundation of their veteran decision-making is often based on this thoughtful, data-driven approach.

In the context of a high post-test probability for malaria, most clinicians would advise treatment (Davey, 2001; Simoes *et al.*, 2003). However, the implications of a false-positive diagnosis, leading to inappropriate treatment, must also be considered (Chandler *et al.*, 2008). In the case of Sara, this would unnecessarily expose Sara to the risks of antimalarial medications and, more importantly, delay the diagnosis and treatment of her actual disease.

Any individual physical finding may not have significant sensitivity or specificity for clinical malaria (Bisoffi & Buonfrate, 2013). Splenomegaly, for example, may be absent (falsely negative) in a child's first few attacks of malaria, and these are the cases most likely to be fatal. Since many children (often 50%) in endemic communities have enlarged spleens from prior malaria episodes, there is little correlation between splenomegaly and **current** clinical malaria, thereby lowering the likelihood ratio of splenomegaly for the diagnosis of current clinical malaria (Hackett, 1944; WHO, 2012). Therefore, in the example in Figure 1.4, if the positive likelihood ratio of splenomegaly for current clinical malaria is approximately 2, the post-test probability is raised only modestly, to 67% (red line).

Considering "clusters" of clinical findings or syndromes

Since any one given physical finding may not yield a high likelihood ratio for a specific disease, a skilled clinician will use a combination of findings in the patient's history and physical examination to quickly limit the differential diagnosis. When

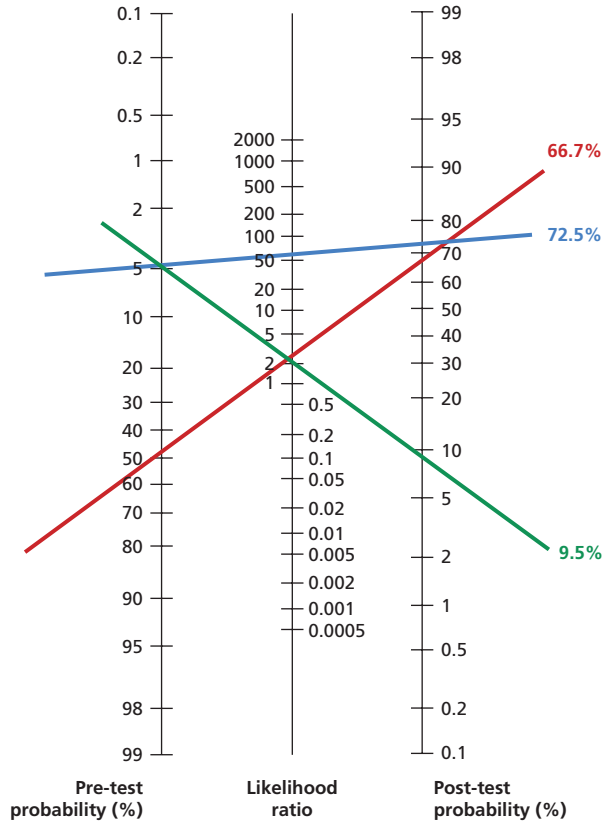

Figure 1.4 Fagan nomogram demonstrating the relationship between pre-test probability, likelihood ratio, and post-test probability (see Figure 1.3 for the definition of likelihood ratio). Many diagnostic calculations, including those in this chapter, are available on several smartphone apps, including MedCalc (www.medcalc.com/bayes.html). Alternately, in the field, one can use the Fagan nomogram and a straight edge. This nomogram, often used for laboratory tests, can also be used to conceptualize clinical decision-making. The red and green lines represent two individual patients who each present with a single clinical finding suggestive of a particular disease. The likelihood ratio is arbitrarily 2 in these examples. However, it is only the patient who comes from a setting where this disease is prevalent (high pre-test probability, red line) that is likely to have that disease. The blue line demonstrates that the presence of multiple or convincing clinical findings for a particular disease (arbitrarily, here, a likelihood ratio of 50) greatly increases the post-test probability of that disease, even in the context of low pre-test probability.

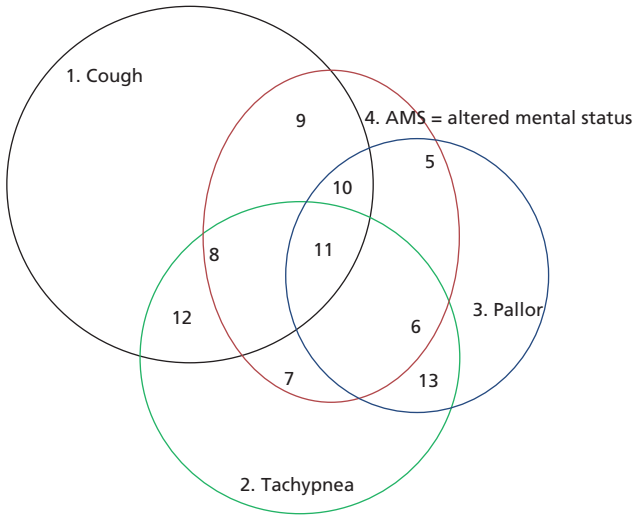

Figure 1.5 Syndromic diagnosis: a Venn diagram of acutely febrile children in sub-Saharan Africa. Total area of rectangle indicates all acutely febrile children in sub-Saharan Africa. Area of colored circles indicates prevalence of each of four clinical signs: cough (black), tachypnea (green), pallor (blue), and altered mental status (red).

combined with epidemiologic assessment of pre-test probabilities of diseases, this very efficient clinical approach considers the likelihood of a combination of findings in order to make a "syndromic diagnosis" (English *et al.*, 2003), as illustrated by the Venn diagram in Figure 1.5. The areas on the diagram are approximate and will vary by time, place, and person. Combinations of findings, or areas of numbered overlaps, are "syndromes" and can suggest specific diagnoses, of which the following are examples.

- Cough (black circle 1) plus tachypnea (green circle 2) suggests pneumonia. If the child has only these two findings (area 12), this is potentially pneumonia, which is much more likely if there is also chest retraction. However, if the child has additional symptoms or combinations (areas 6, 7, 8, and/or 11), the child has complicated pneumonia and/or additional disease(s).
- Palmar pallor (blue circle 3) in the febrile child suggests malaria. If the patient also has altered mental status (area 5) and/or tachypnea (area 6), complicated malaria is likely.
- Altered mental status (red circle 4) in the febrile child suggests meningitis; lumbar puncture is recommended, regardless of other finding, and especially if there are no other findings. In resource-limited settings, where comprehensive work-ups are usually not available, syndromic management becomes increasingly important.

In general, the greater the number of combined findings or elements of a syndrome present, the more likely and specific is the diagnosis of the suspected disease. Palmar pallor (Muhe *et al.*, 2000) could indicate anemia (Montresor *et al.*, 2003; Calis *et al.*, 2008) from a variety of causes. However, the likelihood of malaria is raised if palmar pallor is part of a syndrome of findings consistent with malaria (Taylor & Molyneux, 2003).

As the case of Sara showed us, pneumonia (Shann *et al.*, 1983) and malaria can present with clinical similarities, and both are common among children in this setting (Margolis & Gadomski, 1998; Principi & Esposito, 2011). In The Gambia, for example, among children presenting with overlapping clinical findings in the rainy season, 33% had pneumonia and 38% had malaria (O'Dempsey *et al.*, 1993). In the dry season, 48% had pneumonia and only 6% had malaria. As Sara became seriously ill and comatose, additional or alternative diagnoses must be considered, including tuberculosis meningitis (Wright *et al.*, 1993; Berkley *et al.*, 2001; Weber *et al.*, 2002; Green *et al.*, 2003; Azzopardi & Graham, 2008; Best & Hughes, 2008).

Many health professionals who have trained in resource-rich countries have been taught the concept of "Occam's razor" or diagnostic parsimony. This is an attempt by clinicians to identify a single disease that accounts for nearly all the patient's findings. While this principle is usually also true in resource-limited settings, comorbidity is both common and difficult to exclude without highly sensitive and specific laboratory tests. Broader management may therefore be necessary.

Using laboratory investigations judiciously

Laboratory tests and imaging should serve to increase diagnostic certitude primarily, and perhaps only, when the results will change patient management. The potential harm of investigations should also be considered and weighed against potential benefits. In the case of Sara, for example, the risk of performing a lumbar puncture in a comatose child (who is treated with antibiotics regardless) far outweighs the benefits. Harm may also come from cost and delays in therapy. If treatment for a specific disease (e.g., acromegaly or thalassemia) is unavailable, unaffordable, or culturally unacceptable, use of additional resources to pursue that diagnosis might be injudicious (Pust, 1984b). As mentioned previously, the clinician's role in such a setting may be to advocate for the relevant resources, if consonant with other competing priorities.

Conversely, laboratory confirmation of even a fairly likely diagnosis may be indicated if there are significant implications of a false-positive diagnosis. For example, in the context of increasing resistance to antimalarial drugs, the WHO now recommends laboratory confirmation of malaria before treatment is commenced (d'Acremont *et al.*, 2010; WHO, 2012).

In Sara's case, does a diagnosis of malaria indicate that antibiotic therapy should be ceased (Newton, 2004)? Returning to Figure 1.3, the 2 × 2 table helps conceptualize the potential outcomes of "incorrect" (false-positive or false-negative) diagnoses. Given the comorbidities of serious diseases and the paucity of investigations having high accuracy in resource-limited settings, it is usually better to err on the side of treatment of serious disease (i.e., when a falsely negative diagnosis may be fatal). In Sara's case the physician did not discontinue these antibiotics, which are effective in most cases of bacterial meningitis and pneumonia. The extended case of Sara demonstrates some universal principles of clinical care as applied in resource-limited settings.

In this chapter, diagnosis based chiefly on clinical findings has been emphasized. However, because several simple diagnostic aids are portable and affordable, many clinicians routinely carry these in a pocket or bag. Table 1.2 highlights some diagnostic tools a clinician may consider bringing (and leaving), after consulting with the host institution about their appropriateness.

Implications of diagnosis and treatment

Consider the costs of healthcare in resource-limited settings

In resource-limited settings, it is essential to know the costs of diagnostic and treatment resources. Tests and imaging are costly to health facilities and patients. Even when affordable, many diagnostic modalities in resource-limited settings may not have regular quality control or calibration. Radiographers may not be available to interpret imaging. Many investigations have a long turn-around time, especially those processed elsewhere, thus delaying your patient's care. Non-essential treatments may be prohibitively expensive, resulting in displacement of funds from purchasing other essential items.

Consider the cultural context of clinical care

Diagnosis can be associated with significant stigma. For example, in many cultures there remains great discrimination against people living with HIV. Implications of certain diagnoses should be considered and planned for before any investigations are performed.

Additionally, before prescribing treatment in resource-limited settings (as in any setting), consider its impact on the patient, family, and staff (Hill *et al.*, 2003). Inpatient hospital care may be preferred when resources at home are limited. For example, there may be no clean water to prepare oral rehydration solution for a child with diarrhea. However, hospitalization also can co-opt relatives or friends who have other important commitments (e.g., employment, caring for other family members). Patients may travel great distances at significant cost to reach health services, so consider the need and options for continuing care carefully.

Expatriates, by definition, are guests "working in someone else's country" (Stark, 2011; Pust, 2012). With continued welcome, a short rotation may grow into a longer stay, which may transform into a lifelong relationship. Yet regardless of the length of the experience, a visiting clinician should always have the sincere humility of a guest, a strong mutual respect with the hosts, an eagerness to learn from them, and a shared determination to help build a better future. As Senegalese novelist Cheikh Hamadou Kane explained: "We have not had the same past, you and ourselves. But we shall have the same future. The era of separate destinies has run its course."

Table 1.2 Small diagnostic tools you may consider taking to a resource-limited setting (in addition to these diagnostic tools, see Chapter 4 for a general list of items to pack when traveling abroad).

Clinical items to consider taking when relevant
• Items specifically requested by your host • Portable pulse oximeter: can be very useful at bedside or outpatient triage in distinguishing, for example, "difficult breathing" of malaria (normal oxygenation) versus pneumonia (low oxygenation) (see case study in this chapter) • Peak expiratory flow meter: low-cost meters are now available and can provide reliable lung function test results. A less precise but even lower-cost alternative is the Snider match blowing test, in which a patient's ability to blow out a match at 15 cm (6 inches) is approximately correlated with FEV_1 and PEFR • Tape measures, including those for mid-upper arm circumference (MUAC) (see Chapter 12) • Pocket visual acuity cards that are independent of culture and literacy • Tuning fork(s) (256/512 Hz) for Weber and Rinne hearing tests • 10-g filament to test for protective foot sensation (diabetes and leprosy) • Extra thermometer(s) for spot checks of patient temperature • Pen-lights • Extra batteries for any battery-operated device • Blood pressure cuff with stethoscope • Glucose or Hemoglobin A1C meter and testing strips • Low-tech hemoglobin card test • Rapid diagnostic test (RDT) cards (e.g., for pregnancy, malaria, HIV, syphilis, typhoid) • Fecal occult blood test cards and developer • Urinalysis test strips • Nitrazine pH paper (e.g., when testing for the presence of amniotic fluid in suspected rupture of membranes) • Portable ultrasound: now available at a much lower cost and may help avoid (or facilitate) procedures • Vacuum extractor (VE), for those properly trained in its use. While many resource-limited settings have VEs, they are often underutilized in favor of cesarean section, even when VE is indicated. One small, affordable, lightweight example is the KiwiVac
Clinical items that should *not* be taken
• Anything that the hosts do not support • Medications that are not on the WHO or the country's Essential Drug List (with some exceptions, if requested by your host) • Equipment that is difficult or expensive to maintain (especially if it detracts from methods already in use that are appropriate, cost-efficient, and sustainable) • New, packaged equipment that may require import duties (unless you are prepared to cover these)

Additional resources

This section includes some of the general resources we have found most useful while working clinically in resource-limited settings. For additional topic-specific resources, please also refer to the resources listed in their respective chapters.

Clinical care

- Local clinical guidelines. Before or on your arrival at your destination, seek copies of the locally approved clinical guidelines, which are often adapted from international sources, such as the WHO. These local guidelines may be available on the Ministry of Health website, from your host institution, or from other local partners/NGOs.
- World Health Organization (2013) *Pocket Book of Hospital Care for Children*, 2nd edn. Available at http://www.who.int/maternal_child_adolescent/documents/child_hospital_care/en/index.html
- World Health Organization (2011) *Integrated Management of Adolescent and Adult Illness (IMAI) District Clinician Manual: Hospital Care for Adolescents and Adults*, Vols 1 and 2. Available at http://www.who.int/hiv/pub/imai/imai2011/en/
- World Health Organization (2003) *Surgical Care at the District Hospital*. Available at http://www.who.int/surgery/publications/scdh_manual/en/
- Davidson R, Brent A, Seale A (2014) *Oxford Handbook of Tropical Medicine*, 4th edn. Oxford: Oxford University Press.
- Beeching N, Gill GV (eds) (2014) *Lecture Notes: Tropical Medicine*, 7th edn. Oxford: Wiley-Blackwell.
- Farrar J, Hotez PJ, Junghanss T, Kang G, Lalloo D, White N (eds) (2013) *Manson's Tropical Diseases*, 23rd edn. Philadelphia: Saunders Elsevier.
- Davies AM (2002) *The WHO Manual of Diagnostic Imaging*. Geneva: WHO.
- Guerrant RL, Walker DH, Weller PF (eds) (2011) *Essentials of Tropical Infectious Diseases: Principles, Pathogens and Practice*, 3rd edn. Philadelphia: Saunders Elsevier.

- King M, Bewes P, Cairns J, Thornton J (eds) (2009) *Primary Surgery. Vol. 1, Non-trauma; Vol. 2, Trauma; Vol. 3, Primary anesthesiology*. Oxford: Oxford University Press. Available at http://www.primary-surgery.org/start.html
- Magill AJ, Ryan ET, Hill DR, Solomon T (eds) (2013) *Hunter's Tropical Medicine and Emerging Infectious Diseases*, 9th edn. Philadelphia: Saunders Elsevier.
- Schull CR (2010) *Common Medical Problems in the Tropics*, 3rd edn. Oxford: Macmillan.
- Shah SP, Price DD (eds) (2011) *The Partners in Health Manual of Ultrasound for Resource-limited Settings*. Boston, MA: Partners in Health. Available at http://parthealth.3cdn.net/3ad982b2456f524cf8_kxvm6qpr9.pdf
- Watters DAK, Wilson IH, Leaver RJ, Bagshawe A (eds) (2004) *Care of the Critically Ill Patient in the Tropics*, 2nd edn. Oxford: Macmillan.
- Werner D, Thuman C, Maxwell J (2011) *Where There Is No Doctor: A Village Health Care Handbook*. Berkeley, CA: Hesperian Foundation.

Modern methods in clinical diagnosis and treatment decisions

- McGee S (2012) *Evidence-based Physical Diagnosis*, 3rd edn. Philadelphia: Saunders Elsevier.
- Straus SE, Richardson WS, Glasziou P, Haynes RB (2011) *Evidence-based Medicine*, 4th edn. Edinburgh: Churchill Livingstone.

Sources for setting-appropriate resources and guidelines

- World Health Organization. WHO guidelines approved by the Guidelines Review Committee. Available at http://www.who.int/publications/guidelines/en/
- Médecins Sans Frontières/Doctors Without Borders. Several clinical reference manuals. Available at http://www.refbooks.msf.org
- World Health Organization. Blue trunk libraries: a collection of books for the health district. Available at http://www.who.int/ghl/mobile_libraries/bluetrunk/en/print.html
- Teaching Aids at Low Cost (TALC). TALC selects the most practical books from various publishers and distributes them in LMICs and online at subsidized prices. Available at http://www.talcuk.org
- Hesperian Foundation. Non-profit organization that develops setting-appropriate educational materials, including the series, *Where There Is No Doctor*. http://www.hesperian.org
- African Medical and Research Foundation (AMREF). http://www.amref.org.

Global health courses and curricula

- American Society of Tropical Medicine and Hygiene. Diploma Courses in Clinical Tropical Medicine and Travelers' Health. http://www.astmh.org/certification/certificate.cfm
- Consortium of Universities for Global Health (CUGH), formerly Global Health Education Consortium. Many online clinical modules. Available at http://www.cugh.org/
- University of Arizona. Global health: Clinical and community care. An annual, open, 3-week course since 1982. Described at http://www.globalhealth.arizona.edu/description
- Harvard Medical School. Clinical topics in global health: A practical introduction for preclinical medical students. Available in part at www.mededportal.org/publication/9471. For further details see Nelson BD, Saltzman A, Lee PT. Bridging the global health training gap: design and evaluation of a new clinical global health course at Harvard Medical School. *Medical Teacher* 2012;34:45–51.
- USAID. Global Health eLearning Center. Available at http://globalhealthlearning.org
- Ethical challenges in short-term global health training. A case-based training course in global health ethics. Available at http://www.ethicsandglobalhealth.org

Websites and reports

- World Health Organization's annual World Health Report. Available at http://www.who.int/whr/en/
- UNICEF's annual report on the State of the World's Children. Available at http://www.unicef.org/sowc/
- Measure DHS. Latest Demographic and Health Survey (DHS) data by country. Available at http://www.measuredhs.com/
- Multiple Indicator Cluster Survey. Child health data by country. Available at http://www.childinfo.org/
- CDC Travelers' Health information on vaccination, prophylaxis, and diseases. Available at http://wwwn.cdc.gov/travel/default.aspx
- *The Lancet* global health series, including "Child survival series" (June–July 2003, Vols 361–362); "Neonatal survival series" (March 2005, Vol. 365); "Maternal survival series" (September 2006, Vol. 368); "International child development series" (January 2007, Vol. 369); "Chronic diseases series" (December 2007, Vol. 370); "Neglected tropical diseases series" (January 2010, Vol. 375); "Tuberculosis series" (May 2010, Vol. 375); "Stillbirths" (April–May 2011, Vol. 377).

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