Chapter 15. Returns on Investment in the Continuum of Care for Reproductive, Maternal, Newborn, and Child Health

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Abstract

With competition for available resources across many public and private activities, the necessity of documenting the returns to investing in interventions to improve reproductive, maternal, newborn, and child health (RMNCH) is increasingly realised. This involves not only estimating the cost of a comprehensive package of interventions across the continuum of care, but also assessing their health impact and the full range of economic and social benefits which accrue from improved health outcomes. Benefit-cost ratios indicate high returns on investment in RMNCH in most countries especially when benefits beyond the intervention period are included.

Boxes: 1

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Outline

Introduction

The continuum of care for reproductive, maternal, newborn, and child health (RMNCH) addresses three key dimensions of service delivery across time, space, and type of care (Kerber and others 2007):

- access to needed services throughout the lifecycle, including adolescence, pregnancy, childbirth, the postnatal period, and childhood.
- access to interventions with functional linkages among levels of care in the health system provided by families and communities, by outpatient and outreach services, and by health facilities.
- access to different types of health services and activities, including prevention, promotion, and curative and palliative care (World Health Assembly 2009).

Assessing the returns on investments in the continuum of care for RMNCH requires, on the cost side, a specification of a package of interventions and an estimation of the full costs incurred in the health system to deliver those interventions. On the benefits side, the counterpart of the continuum of care is evidenced in the many dimensions of the health benefits arising from an integrated care program. These benefits are not only in terms of lives saved; they also include the improved health and welfare of mothers and children, and the benefits that arise from expanding women's abilities to plan their pregnancies. These diverse health gains will have a wide range of economic and social benefits. Thus, assessing the returns to investment in the continuum of care for RMNCH also requires a comprehensive attempt to measure the various benefits that accrue to communities, at different stages of the lifecycle, as a result of the interventions. The overall analysis compares costs and benefits,

with regard to their varying patterns over time, to generate benefit-cost ratios and rates of return on the investments.

This chapter assesses the cost and benefits of delivering a set of integrated RMNCH interventions across the continuum of care in countries with high child and maternal mortality. The purpose is twofold:

- To demonstrate that very high returns can be achieved by strengthening investments in the delivery of a suite of high impact interventions
- To underscore the importance of an accurate assessment of those returns, including the full range of costs involved in delivering integrated care across the continuum and the full range of benefits that flow from the interventions.

The analysis on which this chapter is based (Stenberg and others 2013) is, to our knowledge, the first attempt to undertake such a comprehensive analysis of the returns on investment in the continuum of care for RMNCH.

Context of the Analysis

The benefits of improving the health of mothers and children are indisputable, and considerable progress has been made in reducing maternal and child deaths since the publication of *Disease Control Priorities in Developing Countries*, second edition (Jamison and others 2006). The global maternal mortality ratio decreased 19 percent, from 260 per 100,000 live births in 2005 to 210 in 2010 (WHO, UNICEF, UNFPA, and World Bank 2012).The global under-five years of age mortality rate decreased 24 percent, from 63 per 1,000 live births in 2005 to 48 in 2012, (UNICEF, WHO, World Bank, and UN 20130.

Although several factors have contributed to this reduction, including general socioeconomic development, the increased coverage of essential RMNCH interventions has played an important role (WHO and UNICEF 2013).

Notwithstanding this progress, globally in 2012 6.6 million children died before their 5th birthday, and 260,000 pregnant women die every year from preventable complications related to pregnancy and birth. Moreover, progress has been uneven – both among countries and within countries (Barros and others 2012) and a number of countries will not reach Millennium Development Goals (MDG) 4, to reduce child mortality, and MDG 5, to improve maternal health, by 2015.

The remaining challenges in reducing maternal and child mortality are, to a large extent, the effects of uneven attention to the full continuum of care. For example, in the 75 low and middle-income countries (LMICs) that account for more than 95 percent of global maternal and child deaths, coverage of routine diphtheria-tetanus-pertussis (DTP3) immunization has reached a median level of more than 80 percent; however, the coverage of other life-saving interventions is much lower, especially those delivered in the immediate postnatal period (median coverage of less than 45 percent), such as postnatal care for mothers and babies (WHO and UNICEF 2013). Similarly, adolescence remains a neglected age period, as highlighted by a series in *The Lancet* on adolescent health (Cappa and others 2012). The continuum of care, including referral chain, is often less than fully functional in these countries, as shown in research on referrals as part of primary health care and the Integrated Management of Childhood Illness (IMCI) in Tanzania (Bossins and Van Lerberghe 2004; Font and others 2002).

Additional investments are required to sustain gains achieved and to accelerate efforts to address the remaining gaps. With LMICs facing the double burden of communicable and noncommunicable diseases, priorities need to be set to direct resource allocation toward the most effective outcomes.

Investment "wins"

This chapter demonstrates the considerable social and economic returns realized through the effect of investments in RMNCH interventions, building upon and adding more specificity to earlier results. For example, it has previously been estimated that 30 percent to 50 percent of East Asia's dramatic economic growth from 1965-90 can be attributed to reduced child mortality and subsequent lower fertility rates (Bloom and Williamson 1997), and that GDP per capita is increasing by 1.0 percent per year in China and 0.7 percent per year in India as a result of the effect of lower fertility on age structures (Bloom and others 2010).

There are additional reasons why investing in women's and children's health is not only the right thing to do; it is also the smart thing to do.

Improved and Equitable Access

Well-targeted investments along the continuum of care can respond to a fundamental human right--the right to health. Increasing equitable access to RMNCH services is a key strategy for moving closer to universal health coverage (UHC), defined by WHO as when all people obtain the health services they need without suffering financial hardship when paying for them (WHO 2010, p. ix).

Health System Benefits

Investments in women's and children's health strengthen the entire health system. For example, the capacity to provide 24-hour emergency obstetric care requires that health system components, such as qualified health workers, medications, facilities, and a functioning referral system, be in place across geographic areas.

Extended Lifecycle Benefits

Investments in RMNCH bring benefits across age groups. For example, investments in nutrition have long-lasting effects beyond the immediate improvements in the nutritional status, such as improvements in cognitive development, school performance, and future earnings (Ruger and others 2012).

Cost-Effective Interventions

A considerable body of research, including the *Disease Control Priorities in Developing Countries,* volume 2, has established that RMNCH interventions are among the most cost-effective interventions available (Jamison and others 2006). Recent evidence confirms these findings. A study of diarrhea and pneumonia interventions found that 15 highly cost-effective interventions exist that, if implemented at scale, would prevent 95 percent of the deaths from diarrhea and 67 percent of deaths from pneumonia in children under age five years by 2025 (Bhutta and others 2013). Evidence from Afghanistan suggests that an approach combining improved family planning with incremental improvements in skilled attendance, transport, referral, and appropriate intrapartum care in high-quality facilities could prevent 75 percent of maternal deaths at a cost of less than US$200 per year of life saved (Carvalho, Salehi, and Goldie 2013).

Improved Integration of Services

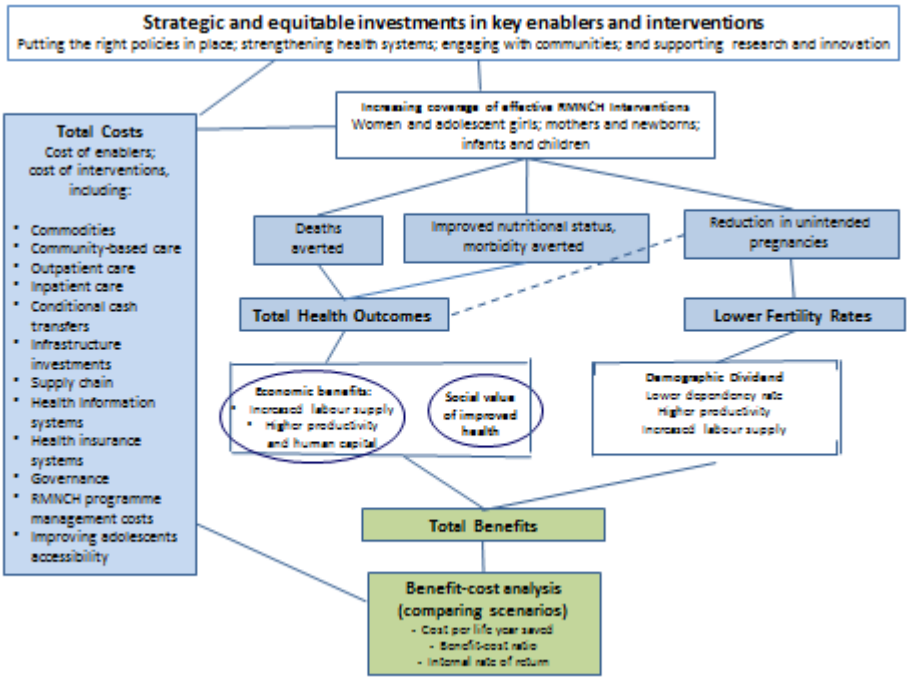
Opportunities exist to deliver additional interventions when women and children present at health facilities, for example, to prevent sexually transmitted infections in conjunction with family planning programs (Church and Mayhew 2009). Findings of the Multi-Country Evaluation (MCE) of the Integrated Management of Childhood Illness (IMCI) suggest that integrated care can lead to cost savings: the annual cost of providing health care to children was considerably lower in districts with IMCI compared to districts without it (Adam and others 2005).

Analytical Framework for Assessing Investments in the Continuum of Care

The conceptual and methodological framework used is summarized in figure 15.1. This framework has three main elements:

- Identification of a suite of essential, cost effective interventions
- Estimation of the health and fertility impacts and the total cost of specific levels of additional investment in these interventions
- Assessment of the economic and social benefits arising from these health and fertility impacts.

Figure 15.1 Conceptual and Methodological Framework



Source: Adapted from Stenberg and others 2013.

Selecting the Interventions

National policy makers are faced with having to make choices regarding which services to provide, while considering a fixed budget allocated by the ministry of finance and other financing partners. Evidence on cost-effectiveness, current health system capacity, feasibility, and acceptability will inform investment strategies. The framework outlined in this chapter includes interventions which were identified in a 2011 review as essential and cost-effective RMNCH interventions (PMNCH, WHO, and Aga Khan University 2011). Table 15.1 lists the 50 selected interventions grouped into six broad packages that follow program structures in many national health systems: family planning; maternal and newborn health; malaria; HIV/AIDS; immunization; and child health, with nutrition included in several packages.

The effective delivery of high quality interventions is dependent on key enablers, including national policies, functional health systems, community engagement, and innovation. Strategies modeled include those supporting both the supply side (for example, expanding health system access through the construction of new hospitals and facilities) and the demand side (for example, mass media campaigns to encourage breastfeeding and care seeking for childhood illnesses).

Table 15.1 Preventive and Treatment Interventions Modeled

Preventive interventions	Treatment interventions
Family Planning	
Modern family planning methods (pill, condom, Injectable, IUD, implant, female sterilization, male sterilization, lactational amenorrhoea method (LAM), vaginal barrier method, vaginal tablets, other contraceptives)	
Maternal and Newborn Health	
• Multiple micronutrient supplementation** • Balanced energy supplementation** • Preventive postnatal care • Periconceptional folic acid supplementation • Calcium supplementation for prevention and treatment of preeclampsia and eclampsia	• Safe abortion* • Post-abortion case management • Ectopic case management • Syphilis detection and treatment in pregnant women • Management of pre-eclampsia with magnesium sulphate • Detection and management of diabetes in pregnancy** • Detection and management of fetal growth restriction** • Labor and delivery management (basic and emergency obstetric care) • Active management of the third stage of labor • Management of eclampsia with magnesium sulphate • Neonatal resuscitation in institutions • Kangaroo mother care • Clean practices and immediate essential newborn care • Antenatal corticosteroids for preterm labor • Antibiotics for Preterm Premature Rupture of Membranes (pPRoM) • Induction of labor (beyond 41 weeks) • Neonatal infections:full supportive care
Malaria	
• Insecticide treated materials • Pregnant women sleeping under an ITN • Intermittent Preventive Treatment - IPT (pregnant women)	• Treatment of malaria in children • Treatment of malaria in pregnant women
HIV/AIDS	
• Prevention of Mother to Child Transmission (PMTCT)	• ART (first-line treatment) for pregnant women • Cotrimoxazole for children • Pediatric ART
Immunization	
• Tetanus toxoid vaccine	

• Rotavirus vaccine • Measles vaccine • DPT vaccination • Hib vaccine • Polio vaccine • BCG vaccine • Pneumococcal vaccine • Meningitis vaccine**	
Child Health	
• Breastfeeding counseling and support; Complementary feeding counseling and support; • Vitamin A supplementation in infants and children 6-59 months	• Oral Rehydration Therapy • Zinc for diarrhea treatment • Antibiotics for treatment of dysentery • Pneumonia treatment in children • Management of severe malnutrition in children • Management of moderate acute malnutrition** • Vitamin A for measles treatment in children

Source: Authors

Note: * In countries where abortion is legal. ** Current analysis includes impact only, not cost.

ART = antiretrovival therapy; BCG = bacille Calmette-Guérin; DPT = diphtheria, pertussis, and tetanus; IUD = intrauterine device; LAM = lactational amenorrhoea method; PMTCT = prevention of mother-to-child transmission.

Estimating the Health and Fertility Impacts and Intervention Costs

The second stage of the analysis is to use modeling tools to estimate the health and fertility impact of the interventions and the intervention-specific investment cost required.

With regards to costs, previous attempts have been made to estimate the resources required to scale up the provision of essential RMNCH services in LMICs. Most of these are disease- or program-specific cost studies that determine costs more or less specific to the disease or age group (Bhutta and others 2013; Singh and Darroch 2012; Stenberg and others 2007). Such studies tend to include patient-level costs--for intervention-specific commodities such as vaccines, bed nets, nutritional supplements--and some estimates of the time of health workers involved in providing the health services. Ideally, these studies would also include program support costs, for example, for training in disease-specific management, epidemiological surveillance; and provision of vehicles specific to the program activities. However, the studies may not always do so, or the specific methods used to estimate such costs are not always well described. Finally, program- or disease-specific estimates may miss resources

needed for broader health system strengthening activities, thereby underestimating the true resource needs for the provision of services. Health strengthening activities that should be considered include pre-service training and deployment of clinical staff; development of functioning referral system; strengthening health information system; and facility infrastructure upgrades. Figure 15.1 shows the 12 components of the full cost of scaling up the interventions that are estimated in the analysis presented in this chapter.

Health and fertility impacts modeled are maternal, newborn, and child mortality, some aspects of morbidity (such as wasting and stunting) and fertility rates.

Assessing the Economic and Social Benefits of Achieved Outcomes

Once the improved health outcomes arising from the interventions–in terms of lives saved, morbidity averted and unwanted pregnancies avoided–are determined, the task is to measure the benefits arising from these better outcomes. Some of these benefits will be strictly economic, in the sense of being reflected in higher GDP as conventionally measured. This will include, for example, higher GDP resulting from increased workforce participation and from higher productivity. However, other benefits, while equally real and certainly economic in a broader welfare sense, will not be reflected in conventional GDP measures. If the life of a mother is saved so that she is able to look after her children and support her community, this has great social value even if she does not enter the paid workforce. Equally, the value of a child's life being saved does not depend only on its participation in the labor force when an adult. We refer to the benefits not captured in existing GDP measures as *social benefits*.

A strong consensus exists among economists that, in measuring economic and social change, there is a need to move beyond production or conventional GDP to sustainable well-being (Stiglitz and others 2009), and that these more inclusive measures are especially important in

relation to health (Arrow and others 2013; Suhrcke and others 2012). Such more inclusive methods can be referred to as *full income methods*. They include additional benefits from improved health outcomes, and more inclusive measures of income, than those included in GDP as it is currently measured.

The recent *Lancet Commission on Investing in Health* (Jamison and others 2013) argued strongly for a full income approach for measuring the benefits of investment in health, defined as measured increases in conventional GDP plus the value of additional life-years gained. The approach presented in this chapter goes further, as we do not limit our analysis to the benefits arising from lives saved. We attempt to include in an explicit manner estimates of economic and social benefits from morbidity averted, and to estimate the economic benefits derived from control of fertility and hence from the reduction in unwanted pregnancies, the *demographic dividend*. Thus, the approach in this chapter allows for a more comprehensive estimate of the estimated benefits than that used in Jamison and others 2013 and other studies.

Measuring the Health Impact and the Full Costs of Investment in the RMNCH Continuum of Care

Estimates were derived for 74 high-burden countries where over 95 percent of the child and maternal mortality occurs (WHO and UNICEF 2013).[1] The list includes 35 low-income countries (LICs); 27 LMICs; 11 upper-middle-income countries (UMICs); and one high-income country (HIC). The investment occurs from 2013-2035, and only health and fertility outcomes brought about by investment up to 2035 are considered. The economic and social benefits of those outcomes, such as lives saved or morbidity averted, continue to accrue for some decades to come and can be taken account of in the investment appraisal.

[1] Of the 75 countries accounting for more than 95 percent of global maternal and child mortality, data limitations prevented inclusion of South Sudan in the analysis.

Modeling an Increase in Coverage Level: Three Scenarios

An investment case may take into account different scenarios in terms of specific packages of services (content), differential levels of investment (level of ambition) and different strategies to achieve the set goals (for example, community-based versus facility-based delivery). At the country level, such differential scenarios should be assessed to inform national policy discussions regarding the most effective resource allocations. Here, for illustrative purposes and in the interest of assessing the benefits of investing in a set of high mortality countries, we scale up the same package of interventions across all countries. Three levels of ambition are defined as *Low, Medium,* and *High* (table 15.2). The analysis assumes that for the Medium and High scenarios, coverage of all 50 interventions (table 15.1) increases over time from a baseline estimate in 2012, reaching successively higher coverage until 2035.

The relative level of coverage across the scenarios drives the difference in intervention costs and impact, whereby the incremental effect of an investment strategy (that is, the Medium and High scenarios) compared to maintaining current coverage without strengthening the health system (the Low scenario) can be assessed and valued. The analysis is centred on the comparison between scenarios, where it is important to note that the main counterfactual in our example is the low scenario with constant coverage levels and a growing population. Accordingly, the results should not be interpreted as additional spending above current levels of health expenditure, but rather as what would be the cost and impact of bending the curve and accelerating progress compared to a low scenario where coverage remains at the 2012 level while population increases.

Table 15.2 Parameters of the Investment Analysis

Overall parameters		
Years of investment cost	2013-35	
Years for which benefits are estimated	2013-35 (health benefits) 2013-70 (economic and social benefits)	
Population considered	4.9 billion in 2013 (74 countries) UN, Department of Economic and Social Affairs, Population Division. World population prospects: the 2012 revision, key findings and advance tables. http://esa.un.org/wpp/Documentation/pdf/WPP2012_%20KEY%20FINDINGS.pdf	
Costs considered		
Service delivery costs	• **Inpatient care:** costs represent the "hotel" component of hospital costs, i.e., excluding the cost of drugs and diagnostic tests but including costs for personnel and infrastructure running costs. • **Outpatient care:** human resources and infrastructure running costs. • **Community-based care**: a proxy value is applied, assuming that the running cost of community based care would cost a third of care provided at health centres.	
Intervention specific direct costs	Drugs, vaccines, laboratory tests, and medical supplies based on treatment guidelines	
Program administration costs	• **General**: In-service training activities, development of pre-service training materials, distribution of printed information materials, mass media campaigns, supervision of community health workers, routine program management • **Specific for Improving adolescents accessibility to health services**: costs included for general program coordination at national- and district level of Adolescent Friendly Health Services (AFHS), development and distribution of national standards for AFHS, in-service training on AFHS, information and communication activities, and upgrade of infrastructure and equipment to adolescent friendly standards	
Health systems costs	• Capital investments in infrastructure, primarily related to construction of hospitals, facilities and health posts. Capital investments are assumed to take place during the first 12 years only (2013-24) to accommodate for expansion in service delivery • Operational costs for transporting additional RMNCH commodities throughout the supply chain • Investments in equipment and procedures for better health information management • Administration of social health insurance in selected countries • Investments in procedures for improved governance and management of resources	
Scenarios considered	Health interventions	Family Planning
LOW This scenario assumes that coverage is maintained at current levels.	• Coverage is maintained at predicted current levels (2012). • It is assumed that with constant coverage, mortality rates do not change over time.	• Coverage is maintained at predicted current levels (2012). • Population growth is as would occur with current contraceptive use, fertility and mortality profiles of the 74 countries. The total population will continue to increase over time, along with the cost of providing services; the absolute number of deaths will also increase.
MEDIUM This scenario assumes scale-up according to currently available historic trends for expanding coverage in each of the countries based on data for years	Rates of coverage increase according to model predictions based on country-specific historical data • Coverage across the 50 interventions reaches on average 60 percent by 2035. For newer vaccines (rotavirus, Haemophilus Influenza Type b (Hib) and pneumococcal vaccines), predictions of rollouts by the GAVI	• Family planning/contraceptive use increases based on trend model data, with the TFR capped at 2.1.

2000-10.	Alliance were used. • For predictions of HIV incidence, PMTCT, ART for children and adults and treatment with cotrimoxazole, projections of UNAIDS data were used.	
HIGH: This is a more ambitious scenario where scale-up coverage is based on accelerating current trends using a best performer approach	Projected coverage values derived from historical trends, using the fastest rate of change achieved by countries at specific coverage levels. • Rates of coverage increase to reach on average 88 percent for the 50 interventions by 2035. • For newer vaccines, predictions are the same as for the Medium scenario. • For predictions of HIV incidence, PMTCT, ART for children and adults and treatment with cotrimoxazole, we applied global targets of 80 percent by 2015, and 95 percent by 2035.	Family planning/contraceptive use increases based on best-performer trends, with TFR capped at 2.1.

Source: Authors.

Note: ART = antiretroviral therapy; LiST = Lives Saved Tool; PMTCT = prevention of mother-to-child transmission; TFR = total fertility rate.

We applied tools that have been developed by the international community, including the OneHealth Tool (box 15.1) to assess intervention-specific costs and health and fertility impacts, while program and systems related costs draw upon estimates of the Taskforce on Innovative International Financing for Health Systems (WHO, 2009) and are described in detail in Stenberg and others 2013.

<<Begin box __.1>>

Box 15.1 Translating Coverage Increases into Cost and Health Impact: The OneHealth Tool

The OneHealth tool (OHT) is a software program that aims to support integrated planning processes in low- and middle income countries, by bringing together disease-specific programme planning and health systems planning. The tool was born out of a review of tools for strategic planning and costing, which found that existing tools did not adequately allow for sector-wide scenario analysis (PMNCH 2008). The OHT aims to facilitate planning that

incorporates health promotion, prevention, treatment, and disease management. The current version (version 4) includes detailed modules for programs such as nutrition, child health, malaria, and non-communicable diseases, as well as modules for health systems planning, for example, human resources, logistics, and infrastructure. It is prepopulated with demographic and epidemiological data by country, as well as input assumptions for prevention and treatment interventions based on WHO-recommended treatment protocols, and estimates the likely health impact (mortality and morbidity) of scaling up coverage. The OHT incorporates preexisting models used by the United Nations' epidemiological reference group, such as the Lives Saved Tool (LiST) (Winfrey and others 2011); the AIDS Impact Model model (AIM) for HIV/AIDS interventions (USAID 2007); Stover 2010; and the FamPlan model, which computes the relationship between family planning and total fertility rate (Bongaarts 1978; USAID 2004). **<<end box __.1>>**

Estimating the Full Benefits of Investment in the Continuum of Care

Key Methodological Assumptions

The costs and the benefits are all defined as the incremental costs and benefits between two scenarios. However, when fertility management tools are an important part of the suite of interventions, the populations in the three scenarios will diverge substantially. The approach we adopt is to assess only those benefits that apply to those alive in the High or Medium scenario, and we compare their situation to what it would have been in the Low scenario.

Three broad types of benefit are identified:

- Some have the benefit of life, because their lives were saved through the interventions.
- Others are in much better health, because of the morbidity averted.
- The whole community has the benefit of higher per capita GDP incomes arising from the reduction in unintended pregnancies and from the processes that the fall in fertility rates set in motion.

The difference in deaths and in morbidity for children between the Low and High/Medium scenarios will reflect two different factors: the impact of the health interventions, for a given level of births, and the reduction in the number of births (due to expanding family planning), for a given level of health. We partition the reduction in child deaths and in morbidity between the Low and High/Medium scenarios into these two components. We use only the former, which we refer to *as lives saved*, in calculating benefits.[1] With respect to maternal deaths prevented, the benefit estimates include all deaths.

GDP per capita paths were derived from World Bank data and combined with population estimates from the OneHealth Tool projections; these are extended to 2070 on the basis of convergence to zero population growth in each country by that year. GDP estimates per capita and assumptions on productivity are combined with data on labour force participation by those affected by the intervention.[2] (International Labour Organization, 2013) .

Economic and Social Benefits of Years of Life Saved

There is a vast literature on the value of a statistical life [3] and, by implication, on the value of life years saved. Most studies use a willingness to pay approach, either in the form of analyses of the revealed preferences evident in wage and risk data or in terms of analyses of stated preferences. Viscusi and Aldy (2003) review the revealed preference literature and

suggest, albeit with a wide uncertainty margin, an implied value for a life year of about 4.0 GDP per capita, with an income elasticity of about 0.6. These two facts, in turn, imply a value for LICs of 1.5 to 2.0 times GDP per capita.

Jamison and others (2012) estimate the value of a life year saved (VLY) as 2.3 times GDP per capita in LMICs at a 3 percent discount rate, with estimates by World Bank region ranging from 1.4 for Latin America and the Caribbean and for the Middle East and North Africa, to 4.2 for Sub-Saharan Africa. Cropper and others (2011) note the recent expansion of the stated preference literature, in which individuals are asked about how they would act in hypothetical situations, and that the value of a statistical life emerging from these studies is much lower than for revealed preference studies.

The revealed preference studies refer to both the economic and social value of a life year, where by economic value we mean that value that would be captured in conventional GDP measures (primarily through labor force effects) and the social value refers to all other benefits of an additional year of life to an individual or a community not captured in GDP. We regard it as useful to distinguish between the social and economic components of the value of a life year saved, as they may have different roles in some investment analyses.

We have constrained the total value of a life year across these two components to 1.5 times GDP per capita for the sample as a whole, which we regard as being at the lower end of the range used in the literature. The calculated economic benefits of increased labour force participation amount to about 1.0 times GDP per capita for the sample as a whole. A social value of a life year saved equal to 0.5 times of the GDP per capita of the full set of sample countries is then applied as a common value across countries. While the strictly economic

value of an additional year of life will vary with local economic parameters, there is no reason to think that the social value is lower in poorer countries than in richer ones. While we do not use any age adjustment for the social value of a life, the effect of our procedure is some discounting of the overall value of a life year for age, and the economic benefits of children's lives saved only begin to accrue when they enter the labor force.

Benefits of Morbidity Averted

Many women and children who survive adverse RMNCH events suffer serious and sustained disabilities (Ashford 2002; Blencowe and others 2013a; Mwanki and others 2012; Sousa and others 2013), which undoubtedly have substantial human, social, and economic costs. The interventions studied here should be expected to generate important benefits through lower morbidity. In spite of its acknowledged importance, few attempts have been made to quantify the burden of maternal and child morbidity or to estimate its economic and social cost; we attempt to begin the process in this study.

While the OneHealth Tool estimates the lives saved as a result of scaling up the interventions, it does not measure the morbidity averted (other than for wasting and stunting) or the impact on mortality in subsequent years from averting the morbidity in the initial year. We estimate morbidity averted for four causes for children (pre-term birth complications, birth injury, congenital abnormalities and malnutrition) and two for mothers (obstructed labour and other maternal disorders), and calculate economic and social benefits.[4] Moreover we derive parameters relating improved nutritional outcomes, in terms of low stature and low birth weight, to lifetime earnings and apply these to estimates of reduced wasting and stunting by country.

Benefits of Reduced Fertility Rates

The third benefit is the economic impact of the reduction in fertility rates, which is well documented in the literature. [5] Ashraf and others (2013) identify a range of channels through which a reduction in the total fertility rate (TFR) affects growth in GDP per capita, which can be grouped into three types of effect, each affecting GDP:

- A dependency effect, as a reduction in births reduces the dependent population. Given that the nondependent population produces the GDP, the fall in the dependent population for a given level of GDP increases the level of GDP per head.
- A labor supply effect, as adults are able to devote more time to working (with fewer births, there will be an increased propensity of women and other care givers to enter the labor force, leading to increased labor supply per capita and hence to increased GDP per head).
- A productivity effect, covering a range of factors influencing long term productivity, such as higher saving by households and higher investment in schooling . More generally, with lower birth rates, more of the society's resources can be devoted to capital deepening, thereby increasing productivity, rather than to capital widening to meet the needs of the expanding population.

The estimates of the demographic dividend draw on and adjust the methods of Ashraf and others (2013), who developed estimates of key parameters based on a review of relevant literature. We derive from their model an aggregate relationship between the reduction in the TFR and the change in GDP per capita over time, out to 2070, and apply this to the change in the TFR in each country, to estimate the impact on per capita GDP and hence on overall GDP.[6]

Country Case Studies

To illustrate how the investment framework could be applied at country level, we present two case studies of LICs. One is a country in Asia which has seen increased coverage of RMNCH interventions and reductions in the fertility rate to about 2.5. The other is a country in Sub-Saharan Africa, with low coverage of many RMNCH interventions and continued high fertility rates (table 15.3).

Table 15.3 Parameters of Country Case Studies

	Asia case study country	**Sub-Saharan Africa case study country**
Description	A country in Asia that has high coverage of maternal and child health interventions increase, and has managed to reduce fertility rates to less than 2.5	A country in Africa with low coverage of most RMNCH interventions, and subsequently still facing high child and maternal mortality, and high fertility rates
U5MR	Low (<60)	High (>100)
MMR	Low (<100)	Medium (between 100 and 300)
TFR	Low (<2.5)	High (>4)
Current health expenditure per capita (US$ 2011)	Low (<US$50)	Low (<US$50)
Women's labor participation rate	Low (in the range of 50-70 percent)	Medium (in the range of 70-80 percent)
GDP per capita	in the range of US$700-$1,000	in the range of US$500-$800
Coverage increase, Medium scenario	• Use of modern contraceptives scaled from 50 to 53 percent • Interventions surrounding child birth are scaled from below /around 30 percent to 45-60 percent; • Management of childhood pneumonia scaled from 38 percent to 52 percent; and diarrhea management to 80 percent • Exclusive breastfeeding rates (1-5 months) increased from 41 percent to 75 percent	• Use of modern contraceptives scaled from 13 percent to 32 percent • Interventions surrounding child birth are scaled to 70 percent to 99 percent • Management of childhood pneumonia scaled from 42 percent to 69 percent and diarrhea management from 21 percent to 35 percent • Exclusive breastfeeding rates (1-5 months) from 22 percent to 56 percent • HIV interventions reach 50 - 80 percent coverage by 2035

	• HIV interventions reach 67 - 80 percent coverage by 2035.	
Additional estimated costs (US$ 2011) and deaths prevented for Medium Scenario Compared to Low Scenario	• Cumulative additional costs, 2013-35 13.5 US$ million • Per capita costs in 2035, US$ 1.67 • 1.4 million deaths prevented 2013-35	• Cumulative additional costs, 2013-35 3.5 US$ million • Per capita costs in 2035, US$ 4.29 • 2.1 million deaths prevented 2013-35
Coverage increase, High scenario	• Use of modern contraceptives increased from 50 percent to 53 percent • Interventions surrounding child birth are scaled from below /around 30 percent to 95 - 99 percent • Management of childhood illness and other child interventions reach similar levels of universal coverage approaching 95 percent • Exclusive breastfeeding rates (1-5 months) from 41 percent to 75 percent • HIV interventions reach 67 - 100 percent coverage by 2035	• Use of modern contraceptives scaled from 13 percent to 49 percent • Interventions surrounding child birth are scaled to 95 - 99 percent • Management of childhood illness and other child interventions reach similar levels of universal coverage approaching 95-100 percent • Exclusive breastfeeding rates (1-5 months) increased from 22 percent to 99 percent • HIV interventions reach 73 -100 percent coverage by 2035
Additional estimated costs (US$ 2011) and deaths prevented for High Scenario Compared to Low Scenario	• Cumulative additional costs, 2013-35 17.9 US$ million • Per capita costs in 2035, US$ 2.65 • 3.1 million deaths prevented 2013-35	• Cumulative additional costs, 2013-35 2.4 US$ million • Per capita costs in 2035, US$ 6.88 • 3.4 million deaths prevented 2013-35

Source: authors
HIV = human immunodeficiency virus**;** MMR = maternal mortality rate; TFR = total fertility rate; U5MR = under-five mortality rate.

Results

Here we present benefit- cost ratios of investing in RMNCH. For details on costs (in US$ 2011) and health benefits, see Stenberg and others (2013). In brief, the high scenario

would require an extra US$4.48 per capita in 2035, with country estimates ranging from US$1.2 to US$112.7, although the per capita numbers will be higher in earlier years because of frontloading in the infrastructure cost and the increase in population over time. In comparison, a continuation of current trends of scale-up as per the Medium scenario would require the equivalent of US$2.50 per capita in 2035 (country estimates ranging from US$1.9-US$72.5).[7] The Medium compared to the Low scenario would thus require fewer additional resources than the High scenario but would also bring less impact because it would avert fewer deaths.

Table 15.4 shows estimates of total deaths prevented, divided into deaths averted (the reduction in births due to enhanced access to contraceptives) and lives saved (the impact of the health interventions on those who are born. The distribution of deaths across these two categories varies across countries and regions, largely reflecting the importance of fertility reduction in individual countries. In UMICs, for example, where fertility rates are in general already fairly low, 75.6 percent of deaths averted are lives saved.

Table 15.4 Deaths Averted and Lives Saved, High versus Low Scenarios, 2013-35

Country grouping (number of countries in parenthesis)	**Total deaths prevented (million)**	**Distribution of deaths prevented by lives saved and deaths averted (percent of total)**					**Total lives saved (millions)**
		Stillbirths		Maternal deaths	Child deaths		
		Lives saved (percent)	Deaths averted (percent)	Lives saved (percent)	Lives saved (percent)	Deaths averted (percent)	
Low-income countries (35)	78.9	30	70	100	46	54	40.4
Lower-middle-income countries (27)	98.1	40	60	100	58	42	59.9
Upper-middle-income countries (11)	7.8	43	57	100	67	33	5.9
Total (74)	184.9	36	64	100	53	47	106.3
Sub-Saharan Africa (43)	109.3	27	73	100	45	55	54.5
Latin America and the Caribbean (6)	2.9	42	58	100	64	36	1.9
Middle East and North Africa (5)	4.7	22	78	100	48	52	2.2
Europe and Central Asia (5)	0.2	55	45	100	71	29	0.6
South Asia (5)	60.4	47	53	100	64	36	40.7
East Asia and Pacific (10	7.4	61	39	100	86	14	6.5

Source: Authors.

Benefit-Cost Ratios for Investments

Applying a discount rate enables benefits and cost to be expressed in terms of their net present value (NPV). The benefit-cost ratio for a given discount rate is the ratio of the net present value of benefits and costs at that discount rate. The internal rate of return is the discount rate that equates the NPV of costs and benefits, giving a benefit-cost ratio of one.

Table 15.5 reports for all countries considered as a whole, and for groups of countries, the benefit-cost ratios calculated using rising discount rates over the period: 3 percent for the period to 2035, 5 percent for the period to 2050, and 7 percent for the period to 2070. While the 3 percent rate is commonly used in this type of analysis (Jamison and others 2013, appendix 3), the use of rising discount rates for longer periods is one way of taking account of higher uncertainty over the longer term.

Table 15.5 Benefit-Cost Ratios for High compared to Low Scenarios, Selected Periods and Discount Rates

Country grouping	**Number of countries**	**To 2035** (3% discount rate)	**To 2050** (5% discount rate)	**To 2070** (7% discount rate)
All 74 countries	74	8.7	27.6	34.2
Low-income countries	35	7.2	16.9	18.5
Lower-middle-income countries	27	11.3	34.0	41.0
Upper-middle-income countries, excluding China	10	6.1	22.5	30.1
China	1	0.7	2.7	3.8
India	1	15.0	42.8	52.6
Sub-Saharan Africa	43	11.0	32.3	37.9
South Asia	5	12.7	36.2	43.4

High fertility impact countries	27	13.7	40.6	47.4
Asia case study country	1	4.0	9.4	10.5
Sub-Saharan Africa case study country	1	9.9	24.6	27.4

Source: Authors.

Note: * The 27 high fertility impact countries are those in which the estimated demographic dividend by 2035 (comparing the High and Low cases) is 8 percent of GDP or greater. These are Afghanistan, Angola, Benin, Burkina Faso, Cameroun, Chad, Comoros, Congo, Democratic Republic of Congo, Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Iraq, Kenya, Liberia, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Tanzania, Uganda, and Zambia.

The benefit-cost ratios shown in table 15.8 indicate high returns on increased investment in RMNCH in most countries especially when the benefits beyond the intervention period are included. For all countries considered as a group the benefit-cost ratio is 8.7 for the intervention period to 2035 at a 3 percent discount rate, 27.6 at 5 percent for the period to 2050, and 34.2 at 7 percent for the period to 2070. The benefit-cost ratio is generally higher for LMICs and UMICs than for LICs and for those 43 countries in Sub-Saharan Africa and 5 in South Asia where maternal and child mortality is highest.

Analysis of Benefits and Benefit-Cost Ratios by Type of Benefit

Tables 15.6 and 15.7 show the contribution from the three sources of benefits to 2050 comparing the high and low scenarios (using a 5 percent discount rate) expressed in two ways: as a contribution to the overall benefit-cost ratio and as a percentage share of all benefits in NPV terms. These tables illustrate four points about the distribution of benefits.

Table 15.6 Analysis of Contribution to Benefit-Cost Ratio, High versus Low Scenarios, 5 Percent Discount Rate for Net Present Value, 2013 to 2050

Country grouping	**Benefit-cost ratio**	**Direct workforce-related benefits**			**Demographic dividend**	**Economic benefits**	**Social benefits**			**All benefits**
		Lives saved	Morbidity averted	Increase in GDP			Lives saved	Morbidity averted	Total	
		a	b	c = a + b	d	e= c+d	f	g	h = f + g	t = e + h
All 74 countries	27.6	5.7	1.4	7.1	13.3	20.4	6.7	0.5	7.2	27.6
Low-income countries	16.9	1.4	0.3	1.7	5.5	7.1	9.2	0.6	9.8	16.9
Lower-middle-income countries	34.0	4.2	1.2	5.4	20.0	25.4	8.0	0.6	8.6	34.0
Upper-middle-income countries, excluding China	22.5	6.7	1.8	8.5	11.0	19.5	2.8	0.2	3.0	22.5
China	2.7	1.3	0.3	1.5	0.0	1.5	1.1	0.0	1.2	2.7
India	42.8	5.1	1.5	6.6	21.3	27.9	13.9	1.0	14.9	42.8
Sub-Saharan Africa	32.3	4.1	0.8	4.9	17.4	22.3	9.4	0.6	10.0	32.3
South Asia	36.2	4.4	1.3	5.7	18.1	23.8	11.5	0.9	12.4	36.2
High fertility impact countries	40.6	4.7	0.9	5.6	22.0	27.6	12.2	0.7	13.0	40.6
Asia case study country	9.4	1.0	0.4	1.4	1.8	3.2	5.5	0.7	6.1	9.4
Sub-Saharan Africa case study country	24.6	2.0	0.3	2.3	9.6	11.9	12.2	0.5	12.7	24.6

Source: Authors.

Note: Total direct health benefits = increase in GDP from work-related benefits (c) + total social benefits (h).

Uneven Distribution of Demographic Dividend

First, the demographic dividend is unevenly distributed across countries, depending on their capacity to reduce fertility rates. Overall, the fertility policies generate a BCR of 13.3 by 2050 (table 15.6), but the estimated impact of reduced fertility rates in the high scenario is particularly high in 27 countries, where it leads to an increase in GDP per capita of 8 percent or more by 2035. In these countries, which are mainly LMICs, the demographic dividend generates a benefit-cost ratio of 22 on the total investment.

High Direct Health Benefits

Second, the direct health benefits, excluding the demographic dividend, are very high at 14.3 for the sample as a whole. These are much more evenly distributed across countries, 11.4 for LICs and 11.5 for UMICs, excluding China.

Total Economic and Social Benefits Fairly Equal

Third, the economic benefits (excluding the demographic dividend) and the social benefits are about equal for the sample as a whole, on both measures. The benefit-cost ratio generated by the direct workforce benefits alone is 7.1, while that generated by the social benefits alone is 7.2 for the 74 countries. The contribution of direct workforce benefits versus social benefits varies significantly across country income groups; social benefits are much greater than workforce-related benefits in LICs, but the reverse is true in UMICs. This presumably reflects the fact that the economic value of lives saved and morbidity averted is lower in poorer countries, while the social benefits are valued using a sample-wide metric.

Significant Morbidity Benefits

Finally, in spite of the very preliminary nature of the morbidity analysis undertaken, the morbidity benefits are significant, representing 6.8 percent of the total benefits (table 15.7). These results suggest that further detailed work on maternal and child morbidity is both appropriate and necessary.

Table 15.7 Analysis of Contribution to Benefits, High versus Low Scenarios, by percentage shares, 5 Percent Discount Rate for Net Present Value, 2013 to 2050

Country grouping	Direct workforce related benefits			Demographic dividend	Economic benefits	Social benefits			All benefits
	Lives saved	Morbidity averted	Total			Lives saved	Morbidity averted	Total	
	a	b	c= a + b	d	e = c + d	f	g	h = f + g	t = e + h
All 74 countries	20.6	5.1	25.7	48.3	74.0	24.2	1.7	26.0	100.0
Low-income countries	8.2	1.8	10.0	32.2	42.1	54.4	3.4	57.9	100.0
Lower-middle-income countries	12.4	3.4	15.8	58.9	74.7	23.4	1.9	25.3	100.0
Upper-middle-income countries, excluding China	29.7	7.8	37.5	49.0	86.6	12.6	0.7	13.4	100.0
China	46.4	10.6	57.0	0.0	57.0	41.9	1.1	43.0	100.0
India	11.9	3.5	15.5	49.7	65.2	32.4	2.4	34.9	100.0
Sub-Saharan Africa	12.6	2.5	15.1	54.0	69.1	29.1	1.8	30.9	100.0
South Asia	12.2	3.5	15.6	50.1	65.8	31.7	2.6	34.2	100.0
High fertility impact countries	11.5	2.3	13.8	54.3	68.1	30.1	1.8	31.9	100.0
Asia Case Study country	10.5	4.8	15.2	20.0	34.3	58.1	7.6	65.7	100.0
Sub-Saharan Africa Case Study country	7.8	1.3	9.1	39.0	48.1	49.4	2.6	51.9	100.0

Source: Authors.

Note: Total direct health benefits = increase in GDP from work-related benefits (c) + total social benefits (h).

Results from Two Case Studies

The Asian country is considerably larger in terms of population and GDP than the Sub-Saharan African country and has a somewhat higher level of GDP per capita. The Sub-Saharan African country has higher mortality rates for both children and mothers, in addition to the higher fertility rate, and a higher level of labor force participation by women (table 15.3).

While the total cost of the intervention for the Asian country is larger than that for the Sub-Saharan African country, reflecting the disparity in population size, the additional cost per person for the High vs Low scenario is considerably lower at US$2.65 (versus US$6.88). This is due to the higher fertility and maternal and child death rates in the African country, requiring a higher level of intervention and a greater cost per capita. Despite the differences in population size, the numbers of maternal, child, and stillbirth deaths prevented by the interventions are similar in both countries, with a proportionally greater impact in the Sub-Saharan African country.

Table 15.5 indicates high benefit-cost ratio for the Sub-Saharan African country, with results similar to those for the average of all 74 countries and for the group of LICs. While positive, the benefit-cost ratio of the Asian country is more modest, again reflecting the differences in initial fertility and death rates.

A more detailed description of the sources of the benefits that arise from the intervention for the two country case studies is given in tables 15.9 and 15.10. For the Asian country, the biggest contributors to the benefit-cost ratio are those benefits arising from the social value of lives saved and morbidity averted (65.7 percent). The contributions from the increase in GDP

from workforce-related benefits (15.2 percent) and from the demographic dividend (20.0 percent) are more modest but still significant. Considered solely in terms of either the increase in GDP from workforce-related benefits or from the demographic dividend, the benefit-cost ratio still shows benefits outweighing costs (ratios of 1.4 and 1.8, respectively).

For the Sub-Saharan African country, in contrast, the contributions from the economic and social benefits are virtually equal (48.1 percent and 51.9 percent, respectively). The demographic dividend is about twice as important as for the Asian country (39.0 percent), while the contribution from additional GDP is lower (9.1 percent). Again in terms of either the increase in GDP from workforce-related benefits or from the demographic dividend, the benefit-cost ratio shows benefits outweighing costs (ratios of 2.3 and 9.6, respectively) and higher than for the Asian country.

Implications of the Analysis

The analysis presented refers to 74 countries that account for more than 95 percent of global maternal and child deaths. The approach taken goes beyond the standard full income approach to allow for a more comprehensive picture of the returns on investment, by explicitly including estimates of economic and social benefits from morbidity averted, and by estimating the effect of the demographic dividend. The analysis points to six main findings.

Large Economic and Social Returns

First, investments in high impact interventions across the continuum of care in RMNCH have very large economic and social returns in addition to the impact on health outcomes. The BCR of investments in the High scenario for the full country sample is 8.7 in 2035. Findings

are robust to variations of the methods of analysis, such as scale-up scenarios and discount rates.

Affordable Investments

Second, the required investments are affordable for most countries. On average for the 74 countries, an additional US$ 4.48 and US$2.50 per capita would be needed in 2035 to finance the High and Medium scenarios, respectively..

Variable Returns on Investment (by country/region)

Third, the magnitude of returns to investment varies across country groupings. By income the highest returns are realized in LMICs, followed by LICs and UMICs. This finding might be explained by two factors. First, economies of LMICs with higher GDP have higher returns operating through workforce benefits and the demographic dividend compared to LICs. Second, returns in UMICs might be lower, given their already lower mortality rates and stronger diminishing returns.

The findings vary by individual countries, reflecting the epidemiological and demographic situation, current health systems performance, and economic factors that are specific to countries. The substantially different findings of the two country case studies confirms that there is considerable value for individual countries to undertake their own investment analyses, to give results specific to their circumstances. For example, the returns on investment in the Sub-Saharan African country, with low coverage of most RMNCH interventions, and subsequently still facing high child and maternal mortality rates and high fertility rates, are more than twice as large as the example country in Asia, which has managed to increase coverage of RMNCH interventions and reduce fertility rates to less than

2.5. The country case studies confirm the importance of investing in family planning; the effect of the demographic dividend is substantial even when the investment reduces the total fertility rate by a small amount.

High rates of return to a comprehensive approach, including family planning

Fourth, investment in each of the elements in the continuum of care matters. The analysis found that family planning programs generate particularly high returns, especially in countries with current high fertility rates, primarily through its effect on the demographic dividend. We have not separated out the rate of return for investing in maternal versus child health since the analysis deals with investing across the full spectrum of RMNCH; however, we note that there may be specifically high returns to investment in maternal care for adolescents, given that adolescent pregnancies have a much higher risk for both mother and newborn compared to pregnancies among women of higher age groups (Patton and others 2009; WHO 2008, 2011).

Returns on investment vary over time

Fifth, the different types of interventions often generate benefits in different time frames, so that the rate of return varies over time. Returns increase substantially over time, particularly beyond the investment period of 2013-35. For example, at a discount rate of 3 percent, the benefit-cost ratio for the full sample of 74 countries is about four times larger in 2070 (34.2) than in 2035 (8.7). While policy makers often make decision in much shorter time horizons, it is nevertheless important to note that returns are realized well beyond the investment period.

An extended modelling approach

Finally, on a methodological note, the overall economic and social benefits are mainly driven by the demographic dividend generated by the investment. For example, in 2050 the demographic dividend accounts for 48.3 percent of the benefit-cost ratio (74 countries). Workforce-related benefits and social benefits account for about 25 percent each. The relative share of morbidity-averted benefits compared to lives saved benefits is low. The reason for this is that only a few sources of morbidity are included in the modeling and because the gains in morbidity are adjusted for the degree of disability averted. For LICs, the social benefits predominate because these are valued using the average GDP per capita of all countries; the workforce-related benefits are valued using country GDP per person in the workforce.

Conclusions

The analysis extends the full income approach to include estimates of economic and social benefits from morbidity averted, and by estimating the effect of the demographic dividend, thus providing a more comprehensive picture of the returns on investment in RMNCH interventions.

The analysis is limited to the health sector, and does not include costs and returns of some interventions that contribute to improving RMNCH outcomes, such as water supply, sanitation and hygiene, girls' education, empowerment of women and girls, and food fortification.

Nevertheless the results underline the value of addressing remaining gaps. RMNCH concerns should feature prominently in the post-2015 landscape, for example, in the Sustainable Development Goals that are to supersede the MDGs. The development of models that place

greater focus on the morbidity elements of maternal and child health, and the evolution of that morbidity over time, is an important topic for future research.

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Endnotes

[1] The methods by which this is done are discussed in Stenberg and others 2013.

[2] For assumptions on participation rates and labor market productivity of women and children upon entering the labour force, see Stenberg and others (2013).

[3] For reviews see Viscusi and Aldy 2003, Jamison and others 2012 and Cropper and others 2011.

[4] For more details see Stenberg and others 2013.

[5] For a recent review, see Canning and Schultz 2012.

[6] In subsequent work it would be appropriate to take account of the specific characteristics, and especially of the population structure, of each country.

[7] Per capita costs in 2035 for the Low scenario refers to the estimated additional costs by year above estimated resource needs to provide 2012 coverage levels; for *Medium versus Low* and *High versus Low* refers to the difference between the estimated costs in Medium/High and in the Low scenario in 2035, divided by the population in Medium/High in 2035.