

# Reduction in child mortality in Niger: a Countdown to 2015 country case study



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## Summary

**Background** The Millennium Development Goal 4 (MDG 4) is to reduce by two-thirds the mortality rate of children younger than 5 years, between 1990 and 2015. The 2012 Countdown profile shows that Niger has achieved far greater reductions in child mortality and gains in coverage for interventions in child survival than neighbouring countries in west Africa. Countdown therefore invited Niger to do an in-depth analysis of their child survival programme between 1998 and 2009.

**Methods** We developed new estimates of child and neonatal mortality for 1998–2009 using a 2010 household survey. We recalculated coverage indicators using eight nationally-representative surveys for that period, and documented maternal, newborn, and child health programmes and policies since 1995. We used the Lives Saved Tool (LiST) to estimate the child lives saved in 2009.

**Findings** The mortality rate in children younger than 5 years declined significantly from 226 deaths per 1000 livebirths (95% CI 207–246) in 1998 to 128 deaths (117–140) in 2009, an annual rate of decline of 5.1%. Stunting prevalence decreased slightly in children aged 24–35 months, and wasting declined by about 50% with the largest decreases in children younger than 2 years. Coverage increased greatly for most child survival interventions in this period. Results from LiST show that about 59 000 lives were saved in children younger than 5 years in 2009, attributable to the introduction of insecticide-treated bednets (25%); improvements in nutritional status (19%); vitamin A supplementation (9%); treatment of diarrhoea with oral rehydration salts and zinc, and careseeking for fever, malaria, or childhood pneumonia (22%); and vaccinations (11%).

**Interpretation** Government policies supporting universal access, provision of free health care for pregnant women and children, and decentralised nutrition programmes permitted Niger to decrease child mortality at a pace that exceeds that needed to meet the MDG 4.

**Funding** Bill & Melinda Gates Foundation; World Bank; Governments of Australia, Canada, Norway, Sweden, and the UK; and UNICEF.

## Introduction

Countdown to 2015 for maternal, newborn, and child survival<sup>1</sup> reported in its 2012 cycle that only 23 of 74 Countdown countries are on track to achieve the Millennium Development Goal 4 (MDG 4), to reduce by two-thirds the mortality rate of children younger than 5 years, between 1990 and 2015. These aggregate statistics are worrisome, and have led to urgent calls for in-depth analyses of the factors that contribute to the performance of a country in scaling-up interventions effective in reduction of maternal, newborn, and child mortality.<sup>2,3</sup> Countdown responded to this need by commissioning a series of in-depth country case studies, of which this is the first.

The Republic of Niger is a landlocked country in western Africa (figure 1). The Sahara Desert covers about 80% of the country, so about 75% of the estimated 15.7 million population<sup>4</sup> lives in the five of eight administrative regions, in the far south and west of the country (Tillabéry, Dosso, Tahoua, Maradi, and Niamey). Since its independence from France in 1960, Niger was ruled alternatively by civil and military regimes until a coup d'état, in 2010, established a

democratic, multiparty state. The largely subsistence economy is threatened periodically by drought and food insecurity.

Niger is one of the poorest countries in the world, ranking 186 of 187 in 2011 on the Human Development Index.<sup>5</sup> Fertility is high, estimated by the 2006 Demographic and Health Survey (DHS) at 7.1 children per woman.<sup>6</sup> The macroeconomic situation has not improved, as shown in the gross domestic product (GDP) per head in the past decade, and the percent of households living at or below the poverty level has remained more or less stable.<sup>7–9</sup> Total official development assistance (ODA) increased 77% between 1998 and 2010 (US\$421.3 million to \$744.5 million).<sup>10</sup> Although total ODA decreased from 2003 to 2008, ODA to maternal, newborn, and child health increased greatly during that period (209% increase per live-birth and 474% increase per child), as estimated by Countdown on the basis of data from the Organisation for Economic Co-operation and Development.<sup>11</sup> The increases in funding to child health in Niger were attributable to small increases by many donors—many of which had not provided any funding at all in 2003—

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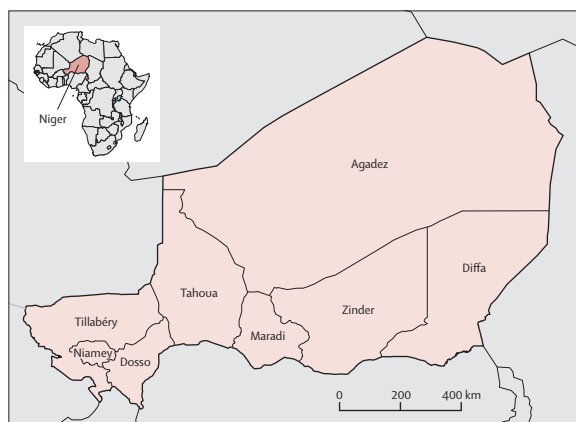


Figure 1: Map of Niger

and larger increases by the GAVI Alliance and the Global Fund especially. Government expenditure on health per head rose from \$5.3 in 1998 to \$9.1 in 2009, with lows of \$4.2 and \$4.7 in 2005 and 2006, respectively.<sup>12,13</sup> On the basis of a reanalysis of the 1998 DHS<sup>14</sup> and a national mortality and child survival survey (ESM)<sup>15</sup> done in 2010 by the Niger National Institute of Statistics (INS), there was only a small increase in the percent of births to women with secondary or higher levels of education, going from 3.2% in 1996–98, to 4.8% in 2008–10. Biodemographic indicators showed little change (appendix).

See Online for appendix

Countdown invited Niger to do this in-depth analysis of their progress in child survival for several reasons. First, the mortality in children younger than 5 years has plummeted in Niger in recent years, outstripping decreases in neighbouring countries.<sup>16</sup> Second, coverage rates for many high-impact interventions monitored by Countdown have shown great increases in Niger, especially since 2005, and the Ministry of Health, the UN Children's Fund (UNICEF), and other partners wanted to confirm and synthesise these results. Finally, since the capacity of the mortality analysis of the National Institute of Statistics (INS) in Niger was expanded in the past 2 years through the Real-Time Results Tracking project, the case study could be done quite rapidly and in country, with leadership by local investigators. INS accepted Countdown's invitation in early 2012, and the Niger Countdown Case Study Working Group was formed with working teams in the areas of mortality, coverage, programme documentation, and contextual factors that could have affected child mortality directly or indirectly by influencing the implementation or effectiveness of child survival interventions.

We explore how Niger achieved these reductions in child mortality. We selected the reference period of 1998–2009 on the basis of the availability of data and because the scale-up of child survival policies and programmes in Niger began in earnest in the early 2000s.

## Methods

### Data sources

For mortality, we identified all available nationally representative survey datasets in Niger that included a full birth history from women of reproductive age (15–49 years) that would allow direct computation of childhood mortality using life table procedures. Available datasets included the 1992, 1998, and 2006 DHSs and the 2010 ESM. We did assessments of data quality on the 2010 ESM with the aim of updating mortality rates to 2009 (appendix) and noted no major issues or discrepancies with the DHS surveys, except for the external consistency check that showed a possible under-reporting of births and deaths by ESM in women aged 30 years and older. The consistency assessment at regional level was conclusive only for five of the eight regions in the country (appendix).

For demographic characteristics and measures of intervention coverage and nutritional status, we used nationally representative household surveys done in Niger between 1998 and 2010. These surveys included the 1998 and 2006 DHS studies, the 2010 ESM, and five Standardized Monitoring and Assessment of Relief and Transitions (SMART) surveys.<sup>17</sup> We learned about the special national survey on insecticide-treated bednets but could not obtain the datasets and assess their quality on time. The appendix provides details on the eight surveys, procedures used for data quality assessment, and definitions of coverage indicators used in the analysis. Data about some standard coverage indicators were not available in the earlier surveys; we used the closest approximation available for which standard measurement was possible across at least three surveys. We used the 1998 DHS and the 2010 ESM survey to estimate fertility and education variables.

We obtained information about child survival policies and programmes by reviewing all relevant documents and databases identified at country, regional, and global levels. We used snowball techniques<sup>18</sup> to identify individuals with first-hand experience in policies and programmes in child survival at any time since 2000; semistructured interviews were done with 40 individuals representing the Ministry of Health and other government institutions, as well as development partners. Findings were reviewed with relevant Government and partner organisations to confirm that they were correct and represented the best available data; where we noted discrepancies in information across sources, we tried to triangulate and arrive at a best consensus estimate for use in reporting.

### Statistical analysis

The analysis focused on the period of 1998–2009. We computed annual child and neonatal mortality rates from 1998 to 2009 using the life table approach.<sup>19</sup> Throughout the text we refer to mortality rate in children younger than 5 years as child mortality. We estimated the annual

rate of mortality decline assuming a constant annual rate of decline using mortality estimates in 1998 and 2009 (appendix). For every annual national mortality estimate, we computed standard errors using Jackknife repeated replications procedures.<sup>20</sup> We computed anthropometric indicators including stunting (height-for-age) and wasting (weight-for-height) in children younger than 3 years of age from information on age, height, and weight using the WHO child growth standards.<sup>21</sup> Moderate or severe (less than 2 standard deviations (SD) below the mean) and severe (less than 3 SDs below the mean) estimates were calculated for both nutritional measures. For years in which two nutritional surveys were done, we used data from the survey for which the period of data collection corresponded to the period of data collection on coverage measures. Infant feeding indicators such as exclusive breastfeeding, complementary feeding, and micronutrient intake such as vitamin A supplementation were calculated by age of the child. Generally, sample sizes for the SMART surveys were larger than those for the DHS, making indicator measurements from the SMART surveys more robust. SMART surveys appear to generate systematically lower wasting estimates than DHS. We did not, however, find any major issues in data quality while comparing the SMART survey data to the DHS data. The 1998 DHS collected anthropometric information only from children aged 0–35 months.

We recalculated all coverage indicators using standard Countdown and Lives Saved Tool (LiST) definitions if the data were available (appendix). Mortality coverage and nutrition analyses were done in STATA statistical software, version 12.0. We then compared the levels of coverage indicators in 1998 to those of 2009.

We used LiST to forecast child mortality in 2009 on the basis of measured baseline values of mortality in children younger than 5 years in 1998 and changes in coverage from 1998 to all years between 2005 to 2009, for which data were available. We present the estimates of lives saved in 2009 rather than cumulative estimates for 1998–2009 because coverage data between 1998 and 2005 were not available and had to be interpolated. We compared the changes in mortality produced by LiST with those produced by the ESM 2010 survey for 1998–2009.

LiST helped us investigate the extent to which the drops in child mortality could be attributed to increases in intervention coverage. LiST uses country-specific or region-specific baseline information on mortality rates and causes of death as well as background variables (fertility, exposure to *Plasmodium falciparum*, stunting rates) and current coverage of more than 60 interventions and their associated effectiveness values<sup>22–25</sup> relative to specific causes of death and risk factors to estimate the deaths averted, overall and by specific interventions. We used 1998 as the baseline year and projected forward to 2009 using all available data on changes in intervention coverage and nutritional status. Specific input values

used in this LiST application are available in the appendix; the Spectrum files are available for download online. The analysis was done with the computer program Spectrum/Lives Saved Tool, version 4.8.

For the Spectrum files see <http://www.jhsph.edu/IIP>

### Role of the funding source

KB is Senior Chief of Child Survival Programme in UNICEF-Niger, and NO is a staff member at UNICEF-New York. Both participated in the case study team and contributed important information on program implementation. Other sponsors of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all of the data used in the study and had final responsibility for the decision to submit for publication.

### Results

The mortality rate in children younger than 5 years decreased rapidly during 1998–2009 in Niger, from 226 child deaths per 1000 livebirths (95% CI 207–246) in 1998 to 128 child deaths per 1000 livebirths (117–140) in 2009, showing an annual rate of decrease of 5.1% (figure 2). The 95% CIs for the point estimates in 1998 and 2009 do not overlap, indicating a significant decrease. The decrease in neonatal mortality was slow and insignificant in this period, ranging from 39 (95% CI 32–46) to 33 (28–39) neonatal deaths per 1000 livebirths.

Overall, the prevalence of moderate or severe stunting in children aged 6–35 months did not decline between 1998 and 2009 (figure 3). It increased slightly in children aged 6–11 months but remained stable in those aged 12–23 months. In children aged 24–35 months, the prevalence of moderate or severe stunting stagnated at 67% (687 of 1022 children) between 1998 and 2005, then oscillated to a lower value at 54% (1003 of 1873 children) in 2009. The prevalence of severe wasting declined significantly for all age groups between 1998 and 2009, with some irregular trends (figure 3). The largest decrease was noted in children aged 6–11 months (from 15.8% [113 of 715 children] to 6.3% [46 of 734 children]), followed

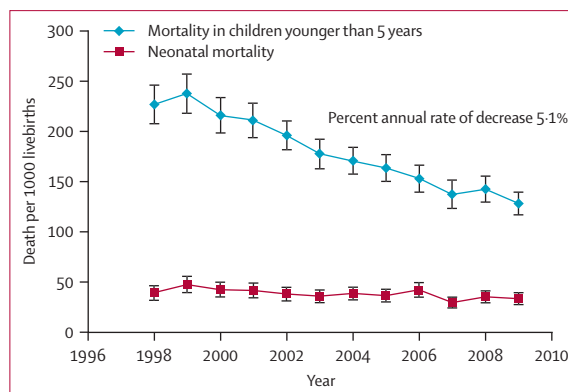
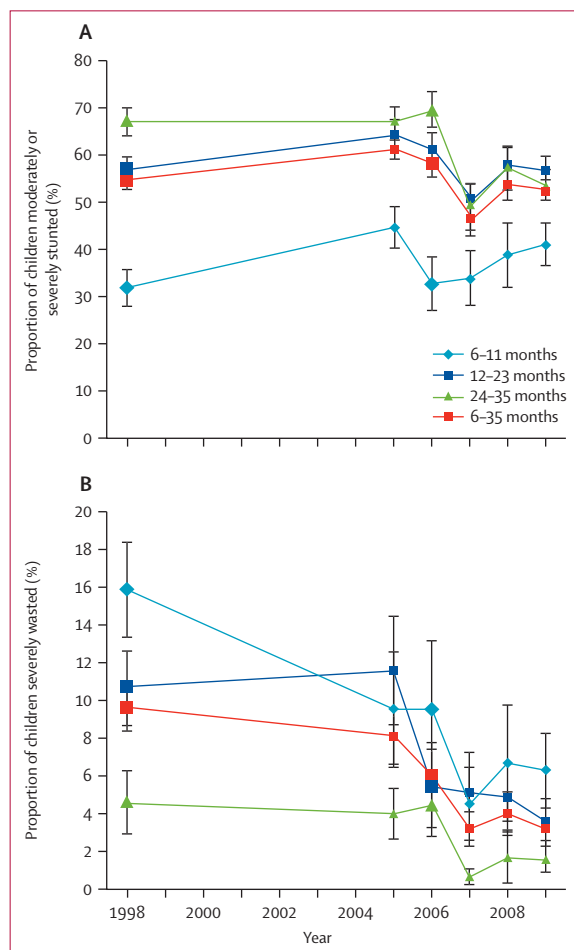


Figure 2: Child and neonatal mortality rates from 1998 to 2009 in Niger. Data based on a national mortality and child survival survey (ESM) in 2010.



**Figure 3: Prevalence of stunting (A) and wasting (B) by age in children in Niger in DHS\* and SMART† surveys, 1998–2009**  
 DHS=Demographic and Health Survey. SMART=Standardized Monitoring and Assessment of Relief and Transitions. The associated 95% CIs \*DHS (1998 and 2006) are shown as large markers. †SMART surveys (2005, 2007–09) are shown as small markers.

by those aged 12–23 months (from 10·6% [137 of 1289 children] to 3·6% [62 of 1702 children]) and those aged 24–35 months of age (from 4·6% [52 of 1126 children] to 1·6% [30 of 1873]).

Figure 4 compares national levels of 14 available coverage indicators across the continuum of care between 1998 and 2009. The largest absolute percentage point increases in coverage were for one dose of vitamin A supplementation and ownership of insecticide-treated bednets for the prevention of malaria (figure 4). One antenatal care visit or more, three doses of combined diphtheria tetanus pertussis vaccine (DTP3), measles vaccination, careseeking for fever or cough, and protection against tetanus showed substantial increases. Important but small increases were noted for careseeking for pneumonia and reported use of oral rehydration salts solution for diarrhoea. Interventions effective in reduction of neonatal mortality such as those related to

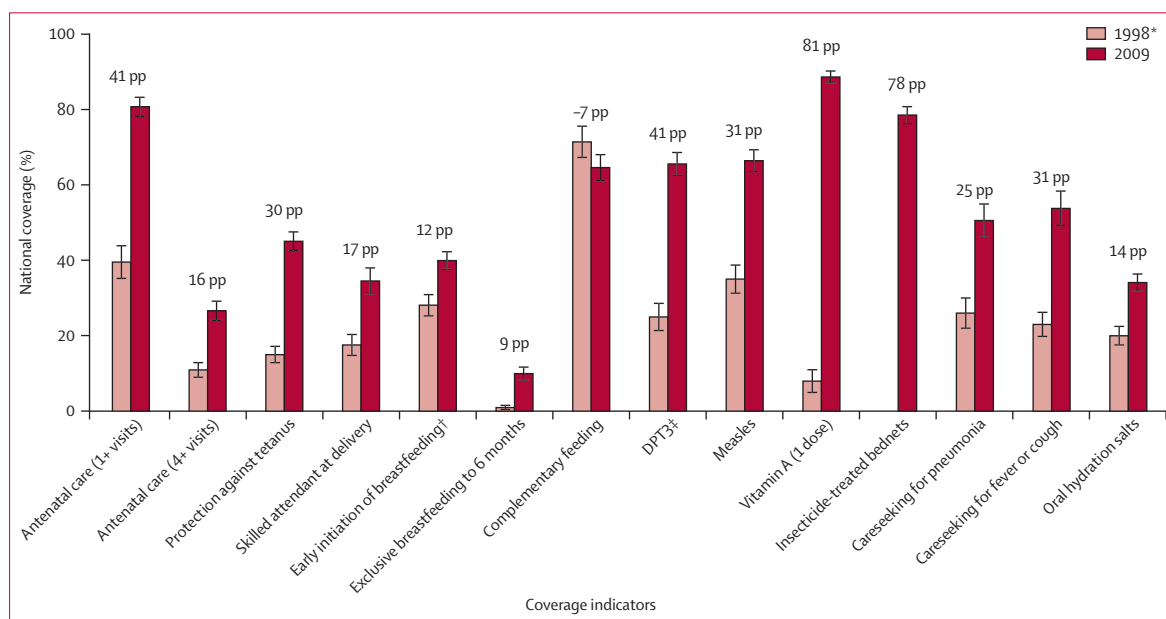
newborn feeding showed generally small increases, although an important increase was noted in the proportion of women reporting the presence of a skilled attendant at delivery. Reports of appropriate complementary feeding for children aged 6–9 months decreased, but this decrease was not significant.

The appendix shows regional results for child and neonatal mortality and nutritional status and intervention coverage. Levels and rates of decline for mortality varied largely regionally between 1997–99 and 2009, both for deaths in children younger than 5 years and in neonates. Coverage levels increased substantially but at varying rates across interventions and regions, and generally seemed to be consistent with regional differences in reductions in child mortality.

Starting at a baseline mortality rate for children younger than 5 years of 226 per 1000 livebirths, LiST predicted mortality in 2009 at 144, and the ESM survey result was 128. For neonatal mortality, starting at a baseline rate of 39 per 1000 livebirths, LiST predicted a rate of 34, and the ESM survey result was 33. These findings permitted us to examine the relative contribution of changes in coverage for specific interventions and changes in nutritional status to the observed reductions in child mortality.

We calculated the proportion of child lives saved in 2009, by intervention or change in nutritional status, using the LiST estimate of 58795 lives saved in 2009 (relative to the situation in 1998) as a denominator (figure 5). The scale-up of insecticide-treated bednets and nutritional interventions seemed to have saved the largest number of lives of children younger than 5 years in 2009, together contributing to about half of the total lives saved (26129 [44%] of 58795). The insecticide-treated bednet scale-up alone saved one in four deaths (14703 [25%] of 58795), followed by reductions in stunting (6074 [10%] of 58795) and wasting (5352 [9%] of 58795). Careseeking for pneumonia, vitamin A supplementation, and careseeking for fever or malaria each contributed to saving 8–9% of lives in 2009 (4588 for pneumonia, 5028 for vitamin A supplementation, and 4903 for fever or malaria of 58795 lives saved). Oral rehydration salts and zinc for diarrhoea, and the measles vaccine saved a little more than 5% of deaths (3184 for oral rehydration salts and zinc and 3123 for measles vaccine of 58795 lives saved). Of the remaining interventions, no one intervention saved more than 4% of child lives in 2009 (figure 5).

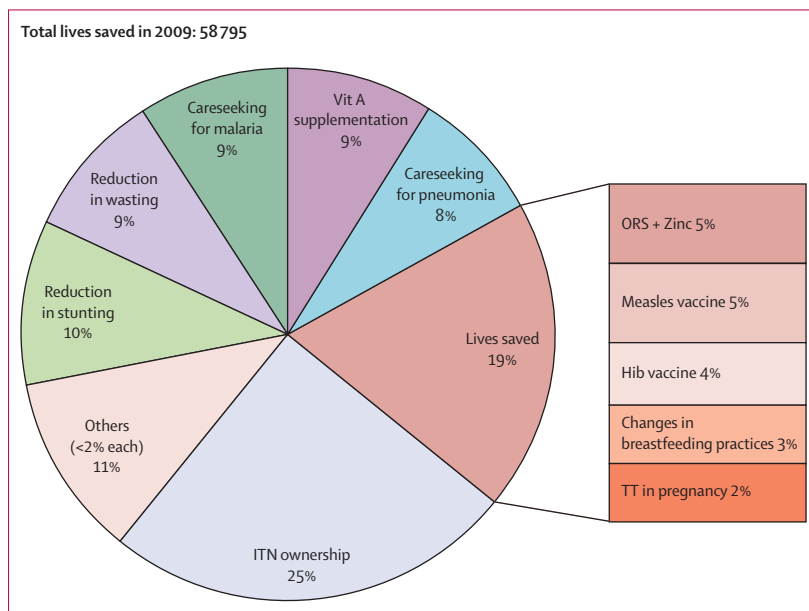
Major policy and programme activities related to child survival took place in Niger from the mid-1990s to 2010 (figure 6). Details are available in the full report of the case study documentation team.<sup>26</sup> Here, we focus specifically on three major strategies implemented in Niger in the past decade: (1) increases in access to child health services, (2) use of mass campaigns, and (3) programming for nutrition. For each we first report on policy support and then on milestones in programme implementation (figure 6).



**Figure 4: National coverage levels and percentage point change (pp) in coverage for high-impact interventions across the continuum of care in Niger as measured in household surveys, 1998 and 2009**

Bars represent 95% CIs. DPT3=three doses of diphtheria, pertussis, and tetanus vaccine. \*1998 DHS only included children aged 0–35 months. †Early initiation of breastfeeding refers to newborn babies put to the breast within 1 h of birth (appendix). ‡Niger switched to Hib vaccine in 2008.

The first strategy used in Niger was to improve universal access to primary health care for women and children (figure 6) beginning in the mid-1990s with the adoption of a national policy for the Integrated Management of Childhood Illness (IMCI). This policy was updated and refined in 2005, and beginning in 2008, paid community health workers in public health posts were authorised to provide integrated community case management (iCCM) for children with fever or malaria, suspected pneumonia, and diarrhoea. In 2000, the President of Niger (Mamadou Tandja) issued a Declaration for Rural Development that called for improvements in access to basic services, including health. These policy statements and a nutritional crisis in 2005 led to a decision in 2006 to improve financial access to services by providing health care free of charge to all pregnant women and children. This decision was followed by programme actions to improve geographic access to services. The first community health posts were built in 2000, and by 2007, nearly 2000 posts had been constructed. These were structures located in rural and remote communities (typically situated more than 5 km from a health facility) and staffed by paid health workers recruited from the community. Data from a UNICEF assessment of the implementation of a new minimum care package for health posts in 2011 indicated that the proportion of the population living within 5 km from an integrated health centre or a health post increased from 48% to 80% during 1998–2009.<sup>27</sup> Beginning in 2005, the Ministry of Health, UNICEF, and other partners focused their efforts to make these posts functional by training



**Figure 5: Percentage of child lives saved in 2009 in Niger, by intervention or cause**  
ITN=insecticide-treated nets. ORS=oral rehydration salts. TT=tetanus toxoid vaccine.

the community health workers assigned to them in basic health-care practices and supplying them with essential drugs and commodities. A functional health post therefore provided a minimum package of high-impact interventions, including treatment for non-severe or uncomplicated malaria (artemisinin-based combination therapy, based on rapid diagnostic testing beginning in

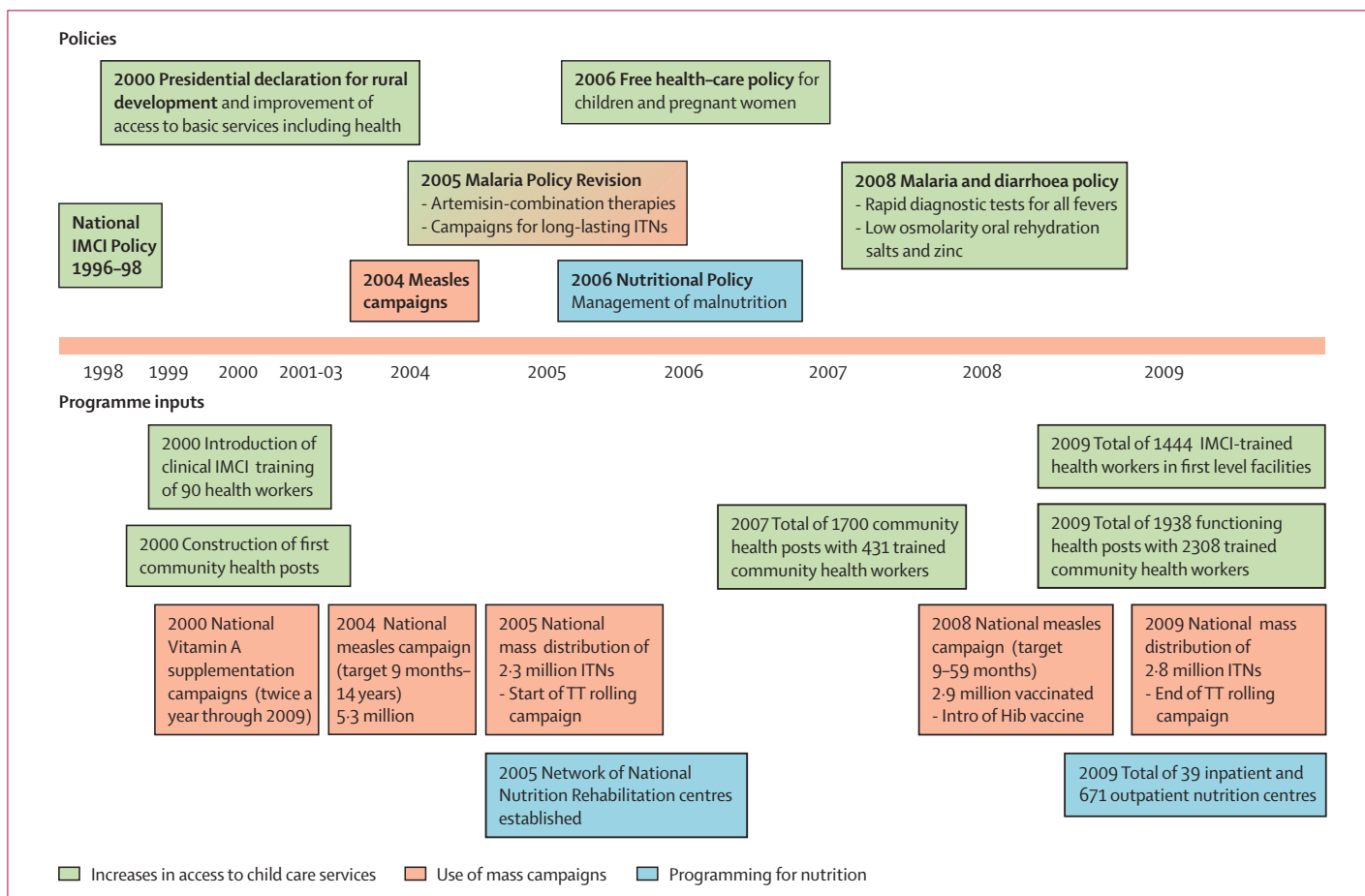


Figure 6: Major policy changes and programmatic activities related to child survival in Niger, 1998-2009  
 IMCI=Integrated Management of Childhood Illness. ITN=insecticide-treated bednets. TT=tetanus toxoid vaccine.

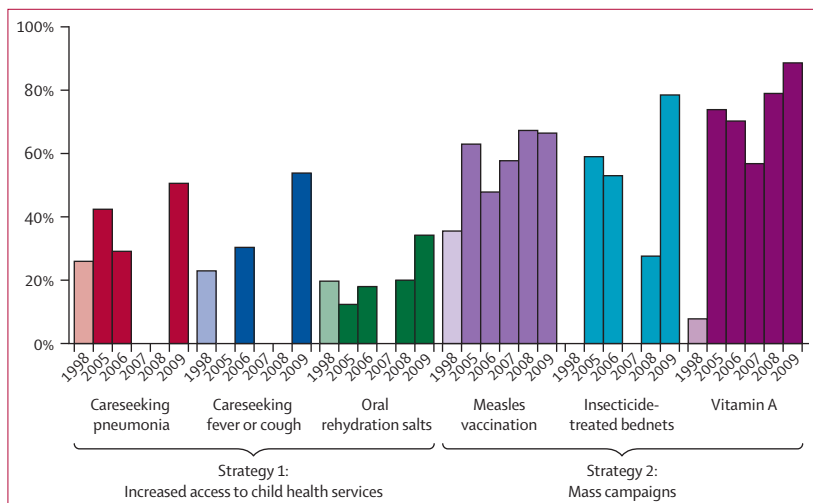


Figure 7: National coverage trends for selected child survival interventions, 1998 and annual from 2005-09

2008), non-severe or uncomplicated pneumonia (antibiotics), and non-severe or uncomplicated diarrhoea (oral rehydration salts, with low-osmolarity salts introduced in

2006); referral for severe or complicated cases of malaria, pneumonia, and diarrhoea; screening and referral for acute malnutrition; promotion of key family practices (infant and young child feeding practices, hand washing with soap, and appropriate care-seeking for sick children); and promotion and distribution of family planning (oral and injectable contraceptives). Zinc was introduced for the treatment of diarrhoea between 2007 and 2009. By 2009, more than 1900 functional health posts were in place. The number of integrated health centres also doubled between 2000 and 2009, from 416 to 802 centres. Training in clinical IMCI for health workers in these centres began in 2000, and by 2009, more than 1400 workers had been trained.

Data from the Niger health information system (Système National d'Information Sanitaire, SNIS) showed steady increases in use of health services during 1998-2009, with steeper increases beginning in 2006, when user fees for pregnant women and children were abolished.<sup>26</sup> Data on cause-specific mortality for malaria provide further support for the hypothesis that, as access to care improved and essential medicines became available closer to children's

homes via the health posts, children with fever received life-saving treatments earlier in the course of the fever episode, and deaths due to malaria decreased. Case fatality rates for malaria in children younger than 5 years, as reported by the national malaria programme, went from 0.27% in 2005 to 0.10% in 2009.<sup>28</sup> Coverage for careseeking for childhood fever or malaria and pneumonia, and for treatment of diarrhoea with oral rehydration salts showed persistent upward trends that are consistent with these programmatic developments (figure 7). Coverage for measles vaccination shows the combined effects of routine delivery and campaigns.

The second strategy was the use of mass campaigns to scale up coverage for selected high-impact interventions (figure 6). Policies in support of measles vaccination campaigns were adopted in 2004, and those in support of the distribution of long-lasting insecticide-treated bednets in 2005. National measles vaccination campaigns in late 2003 and 2008 reached a total of 8.2 million children. This strategy, combined with routine vaccinations provided through the expanded primary health-care system, produced an initial spike in coverage in 2005, followed by steady coverage increases from 2006 to 2009 (figure 7). *Haemophilus influenzae* type B (Hib) vaccine was introduced in 2008 as a part of the pentavalent vaccine programme, and estimates of coverage for 2009 based on DTP3 suggest that coverage shot up to more than 60% in 2009, the first year after it was introduced. Campaigns for the distribution of long-lasting insecticide-treated bednets early in the calendar years of 2005 and 2009 produced spikes in coverage in those 2 years. The effects of two mass campaigns per year for vitamin A supplementation since 2000 are represented in high and sustained coverage for this intervention in 2005–09 (figure 7); the dip in 2007 is attributed to the fact that the campaign was not made until late in the year after the survey had been completed in some regions.

The third strategy was an increased focus on nutrition (figure 6). Policies supporting nutrition were updated in 2006. In 2005, the Government began building a network of nutritional rehabilitation centres, and by 2010, had established 39 inpatient and 671 outpatient centres for the management of malnutrition. Global response to a nutrition crisis in 2005 led to the implementation of targeted cash transfers or food for work and other special initiatives.

## Discussion

New data in 2010 show that Niger reduced its child mortality by 43% between 1998 and 2009, from 226 to 128 deaths per 1000 livebirths. The annual rate of decline was 5.1%, which exceeds the 4.3% needed to achieve MDG 4 for child survival, and is far higher than the rates of neighbouring low-income or middle-income countries such as Benin (2.2%), Burkina Faso (0.8%), Chad (0.9%), Mali (1.8%) and Nigeria (2.0%) as estimated in 2010.<sup>1</sup> How has Niger achieved this?

Our findings suggest that three programme strategies worked synergistically to achieve these decreases in child mortality. First, the Government of Niger gave high priority to achieving universal access to primary health care for women and children beginning in the mid-1990s, with special attention to achieving high coverage for interventions that are effective in reducing deaths from malaria, pneumonia, diarrhoea, and measles. They expanded geographic access by building health centres and peripheral health posts, and, beginning in 2005, they made intensive efforts to increase the functionality of these facilities by training staff and strengthening distribution systems for essential commodities. In 2007, the Government of Niger created a cadre of paid community health workers to provide high-impact promotive, preventive, and curative interventions for maternal and child health at the peripheral health posts. The community health workers were functionally integrated within the broader health system, as recommended by the Global Health Workforce Alliance.<sup>29</sup> These workers began providing treatment for the main causes of child deaths and the Government of Niger increased financial access by abolishing user fees for pregnant women and children in 2006. The combination of these two steps led to increases in timely careseeking for and life-saving treatment of childhood illnesses. The transition from user fees to free services for pregnant women and children was helped by several factors, such as strong political commitment from the government and increases in social sector spending by the government (notably in the scale-up of paid health staff, support to the supply of essential commodities, and supervision), made possible by debt relief through the Enhanced Heavily Indebted Poor Countries Initiative in 2000<sup>30</sup> and increases in ODA targeting maternal and child health.<sup>31</sup> These factors align with the steps required for successful policy change from fee-for-services to free services.<sup>31</sup> Second, rapid scale-ups in coverage for insecticide-treated bednets, measles vaccination, and vitamin A supplementation were achieved through the use of mass campaigns. Third, important efforts were made to address child undernutrition both through the development of a network of management services and through emergency programmes established in response to a nutritional crisis in 2005 and 2006.

The available evidence suggests that it was these three effective strategies (increases in access to child health services; use of mass campaigns; and programming for nutrition), operating together, that caused the greatest part of the reduction in child mortality. Changes in the more distal determinants of child survival were small and cannot explain more than a small proportion of the mortality reduction. We noted no important changes that we would expect to affect childhood mortality in a range of biodemographic variables, GDP, or the percent of the population living in poverty. The LiST estimate of child mortality in 2009 is 144 deaths per 1000 livebirths, on the basis of measured changes in coverage and nutritional

status throughout 1998–2009. This is only slightly higher than the measured mortality for 2009, suggesting that the effects of changes in distal determinants that were not channelled through increases in intervention coverage and reductions in stunting and wasting are small. The weight of the evidence, therefore, supports the claim that Niger successfully scaled up effective interventions in child survival and thereby achieved rapid declines in child mortality.

The results on neonatal mortality offer further, if negative, support for this claim. The neonatal mortality did not decrease significantly between 1998 and 2009. We noted a consistent but slow trend from 52·3 (DHS 1992) to 44·2 (DHS 1998) to an estimate in the mid 30s (ESM 2010). The few interventions with proven effects on neonatal mortality for which trend data on coverage are available show only small increases from 1998 to 2009. For example, the percentage of mothers reporting four or more antenatal care visits increased by 16 percentage points and protection against tetanus by 30 percentage points; increases that are much smaller than those for interventions targeting older children. The increase of 17 percentage points in the presence of a skilled attendant at birth compares favourably with the mean increase of eight percentage points for the period between 2000–05 and 2006–11 reported for the 61 Countdown countries with data for both periods;<sup>1</sup> our programme documentation efforts suggest that this gain is likely to represent increased access to services but not improvements in the quality of care received by women and newborns during delivery. An assessment of the quality of maternal and newborn care done by the Ministry of Health in 2010, showed that few health workers who were present at birth had the knowledge, skills, or basic equipment to manage newborn problems effectively.<sup>32</sup>

Niger's successful experience in the reduction of child mortality can serve as a basis for moving forward with intensified efforts to reduce deaths in newborn babies. This case study focused on child survival; a similar case study focusing on maternal and newborn health and survival would be useful.

Food security was precarious in Niger throughout 1998–2009 (appendix), but the potential negative effects seem to have been offset somewhat by government and partner policy and programme response between 2006 and 2009. Periodic climate shocks (eg, flooding) and conflict would be expected to increase wasting prevalence and have a dampening effect on mortality reduction; relief efforts seem to have been effective in counteracting at least part of this effect. The results suggest that nutrition programmes—both routine and in response to the periodic nutritional emergencies since 2005—were effective in combination with interventions in child health in reducing risks to child survival presented by stunting and wasting, and improving the resiliency of children, caregivers, and communities. There is room to strengthen the routine programmes further and save more lives, as shown in the slow increases for indicators of infant and child feeding patterns. A new nutrition strategy that focuses on reduction of stunting is being developed.

Data limitations should be kept in mind when reviewing these results (panel). Our quality assessments showed that the ESM 2010 survey produced high-quality data on mortality at national level, but data for three of Niger's eight regions were not usable. Assessments of intervention coverage and nutritional status were based on both DHS and SMART surveys after careful review and independent recalculations of indicators, but issues with data quality and comparability might still exist. Efforts to document programme activities retrospectively were difficult—programme staff had changed and little institutional history or formal record keeping existed. Discrepancies were noted across data sources, as were gaps in information.

We have learned valuable methodological lessons in the process of doing this case study that we hope will be useful to other countries interested in doing something similar. These lessons include the need to take a longer retrospective perspective—in this case a decade—to allow time for government commitment and policies to be scaled up and realise their effects on coverage, nutritional status, and mortality. Second, we believe that our multi-pronged effort to assess changes across the entire child survival impact model<sup>33</sup> from inputs and processes (policies, resources, and strategies) through outputs (infrastructure, trained personnel, commodities, and use of services) and outcomes (coverage and practices) to effect (mortality and nutritional status) allowed us to explore and explain the causes of mortality change more thoroughly than has been done in the past, and justified the time and resources needed to do the case study. Further qualitative work is underway to explain more

#### Panel: Research in context

##### Systematic review

We searched PubMed for all articles in the past 10 years with titles or abstracts containing the MeSH terms "Niger" in the title or abstract, and "child", "mortality", "survival", "child welfare", or "child health" anywhere in the article. For mortality, nutritional status and intervention coverage we identified all nationally-representative household surveys done since 1995 and assessed every survey for data quality by examining the datasets for missing and out of range values, and by reviewing survey procedures such as surveyor training and supervision with the individuals who did each survey. For information on programme activities, we used snowball techniques to interview all individuals we could identify who were involved in activities related to child survival in Niger between 2000 and 2009. We did 40 interviews, and abstracted all available data, reports, and records into excel spreadsheets.

##### Interpretation

This study adds to the totality of information available on child survival declines in Niger by codifying, for the first time, policies, programmatic strategies, and what was actually done on the ground and linking these actions to the results produced in terms of intervention coverage and declines in child mortality and undernutrition. This highly-contextualised analysis can help ensure that the findings are generalised only to settings with comparable characteristics.



fully why the strategies adopted in Niger were successful, and the broader leadership, governance, and management context. Our experience also reconfirmed that of previous large-scale assessments in highlighting the challenges of constructing retrospective descriptions of policies and programmes,<sup>34</sup> and suggests that further research and development is needed on methods for prospective recording of the policy context and the strength of implementation. LiST added value by allowing us to examine the contribution of specific interventions and nutritional status to overall mortality reduction. This examination was possible only because the overall estimates of mortality produced by LiST were generally consistent with measured mortality; which might not be true in other settings. Analyses of the equity dimensions of these results are underway and will be presented in a separate report.

In summary, the Government of Niger achieved great reductions in child mortality by responding forcefully to opportunities and constraints in their context. They created a conducive policy environment focused on high-impact interventions, and operationalised those policies in ways that improved financial access to services (by eliminating user fees for children and pregnant women) and improving geographic access to services. Niger—with lower levels of resources and at least equal environmental challenges relative to neighbouring countries—has sprinted toward universal primary health-care coverage and higher rates of child survival. This case study shows the value of taking a broad approach to understanding country-level programming for women and children, and producing information that can be used in Niger and other settings to reduce unnecessary deaths. Niger is an unusual context, and has produced remarkable results for child survival that can set the bar for other countries in the region and worldwide.

#### Contributors

AA, MM, and KH conceptualised the mortality analysis and data quality assessments, which were done by them and OH, IM, GMM, and DMA. EH led the work on quality assessment and reanalysis of datasets on coverage and nutritional status, with participation by MHM, MM, and EW. KB led the programme documentation component of the study, HLT and MA did the work and drafted the report. NO prepared the data and analysis of contextual factors with assistance from KH. NW did the LiST analysis. All authors participated in a week-long workshop in Niamey in July 2012, to review and interpret the preliminary results. JB prepared the proposal and work plan for the study and served as the liaison to Countdown. AA and JB prepared the first draft of the report. All authors reviewed and contributed to subsequent drafts and approved the final version for publication.

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#### Conflicts of interest

We declare that we have no conflicts of interest.

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#### References

- 1 Requejo J, Bryce J, Victora C, and the Countdown to 2015 report writing team. Countdown report 2012. Building a future for women and children: the 2012 report. Washington DC: World Health Organization and UNICEF, 2012.
- 2 Bhutta ZA, Chopra M, Axleson H, et al., Countdown to 2015 decade report (2000–10): taking stock of maternal, newborn, and child survival. *Lancet* 2010; **375**: 2032–44.
- 3 WHO. Commission on information and accountability for women's and children's health. Keeping promises, measuring results. Geneva: World Health Organization, 2011.
- 4 Institut National de la Statistique du Niger (INS). Projections actualisées de la population du Niger 2005 à 2050: cahier des données démographiques 2005–15. Niamey: INS, 2010.
- 5 United Nations Development Program. Human development report 2011. [http://www.undp.org/content/undp/en/home/librarypage/hdr/human\\_developmentreport2011.html](http://www.undp.org/content/undp/en/home/librarypage/hdr/human_developmentreport2011.html) (accessed Aug 13, 2012).
- 6 Institut National de la Statistique (INS) et Macro International Inc. 2007. Enquête démographique et de santé et à indicateurs multiples du Niger 2006. Calverton, Maryland, USA: INS et Macro International Inc.
- 7 Institut National de la Statistique du Niger (INS). Troisième enquête nationale sur le budget et la consommation des ménages, Niger 2007. Niamey: INS, 2007.
- 8 Institut National de la Statistique du Niger (INS). Enquête nationale sur les conditions de vie du ménage 2005 (ENCVM). Niamey: INS, 2005.
- 9 WHO. Global Health Expenditure Database. National health account indicators. Geneva: World Health Organization. <http://apps.who.int/nha/database/PreDataExplorer.aspx?d=1> (accessed July 20, 2012).
- 10 Organization for Economic Co-operation and Development (OECD). <http://stats.oecd.org/> (accessed July 13, 2012).
- 11 Pitt C, Greco G, Powell-Jackson T, Mills A. Countdown to 2015: assessment of Official Development Assistance to Maternal, Newborn and Child Health. *Lancet* 2010; **376**: 1485–96.
- 12 Ministère de la Santé Publique et de la Lutte contre les Endémies. 2005. Compte nationaux de la santé. Exercice 2002–2003. Niamey, République du Niger.
- 13 Ministère de la Santé Publique et de la Lutte contre les Endémies. 2011. Compte nationaux de la santé. Exercice 2008–2009. Niamey, République du Niger.
- 14 Attama S, Seroussi M, Kourguéni AI, Koché H, Barrère B. Enquête démographique et de santé, Niger 1998. Calverton, MD, USA: CARE International Niamey, Niger and Macro International 2, 1999.
- 15 Institut National de la Statistique (INS). Enquête nationale sur la survie des enfants de 0–59 mois et la mortalité au Niger 2010. Niamey: INS, 2011.
- 16 Inter-agency Group on Mortality Estimation. Statistics by area: child survival and health. [http://www.childinfo.org/mortality\\_igme.html](http://www.childinfo.org/mortality_igme.html) (accessed July 23, 2012).

- 17 SMART. 2006. Measuring mortality, nutritional status and food security in crisis situations: SMART methodology. Version 1, April 2006. [http://smartmethodology.org/documents/manual/SMART\\_Methodology\\_08-07-2006.pdf](http://smartmethodology.org/documents/manual/SMART_Methodology_08-07-2006.pdf) (accessed July 28, 2012).
- 18 Biernack P, Waldorf D. Snowball sampling: problems and techniques of chain referral sampling. *Sociol Methods Res* 1981; **10**: 141–63.
- 19 Preston SH, Heuveline P, Guillot M. Demography. Measuring and modeling population processes. Malden: Blackwell Publishers Inc, 2010.
- 20 Lohr SL. Sampling design: design and analysis. 2nd edn. Boston: Books/Cole Cengage Learning, 2009.
- 21 WHO. The WHO child growth standards. Geneva: World Health Organization <http://www.who.int/childgrowth/en/> (accessed July 23, 2012).
- 22 Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, Debernisi L. Evidence-based, cost-effective interventions that matter: how many newborns can we save and at what cost? *Lancet* 2005; **365**: 988–97.
- 23 Bhutta ZA, Ahmed T, Black RE, et al. Maternal and child undernutrition 3: what works? Interventions for maternal and child undernutrition and survival. *Lancet* 2008; **371**: 417–40.
- 24 Fox M, Marterell R, van den Broek N, Walker N, eds. Technical inputs, enhancements and applications of the Lives Saved Tool (LiST). *BMC Public Health* 2011, **11** (suppl 3): S1–19.
- 25 Sachdev HPS, Hall A, Walker N, eds. Development and use of the Lives Saved Tool (LiST): a model to estimate the impact of scaling up proven interventions on maternal, neonatal and child mortality. *Int J Epidemiol* 2010, **39** (suppl 1): 1–205.
- 26 Bensaid K, Taylor HL, Abani M. Documentation of child survival interventions in Niger, 2000–10. Niamey: UNICEF-Niger. [http://www.unicef.org/infobycountry/niger\\_65813.html](http://www.unicef.org/infobycountry/niger_65813.html) (accessed Sept 13, 2012).
- 27 Ministère de la Santé. 2012. Accélération de l'atteinte des Objectifs du Millénaire pour le Développement (OMD 4, 5 et 6) Santé. Développement d'une approche communautaire intégrée autour de la case de santé. Promotion du paquet minimum d'activités de la case de santé. Direction Générale de la Santé; Direction de l'Organisation des Soins. Niamey, République du Niger.
- 28 Programme National de Lutte contre le Paludisme. Situation du paludisme au Niger de 2000 à 2010. Ministère de la Santé Publique, Direction Générale de la Santé Publique, Direction de la Lutte Contre la Maladie et les Endémies. Niamey, République du Niger, 2011.
- 29 Global Health Workforce Alliance. 2010. Global experience of community health workers for delivery of health related millennium development goals—a systematic review, country case studies, and recommendations for integration into national health systems. <http://www.who.int/workforcealliance/knowledge/themes/community/en/index.html> (accessed Aug 11, 2012)
- 30 International Development Association and the International Monetary Fund. 2000. Decision point document under the enhanced heavily indebted poor countries (HIPC) initiative. <http://www.imf.org/external/np/hipc/2000/ner/niger.pdf> (accessed Aug 11, 2012).
- 31 McPake B, Briki N, Cometto G, Schmidt A, Araujo E. Removing user fees: learning from international experience to support the process. *Health Policy Plan* 2011; **26** (suppl 2): ii104–17.
- 32 Institut National de la Statistique. Enquete nationale sur les besoins en soins obstétricaux et néonataux d'urgence au Niger. Niamey, République du Niger, 2011.
- 33 Bryce J, Victora CG, Boerma JT, Peters DH, Black RE. Evaluating the scale-up to MDGs 4 and 5: a common framework. *Int Health* 2011; **3**: 139–46.
- 34 Bryce J, Gilroy K, Jones G, Hazel E, Black RE, Victora CG. The Accelerated Child Survival and Development program in west Africa: a retrospective evaluation. *Lancet* 2010; **375**: 572–82.