Institution: The University of Edinburgh

Unit of Assessment: 1

Title of case study: Q: Accurate epidemiological pneumonia incidence and mortality estimates have influenced child health policy to reduce global child pneumonia mortality

1. Summary of the impact (indicative maximum 100 words)

Impact: Health and welfare; raised awareness of childhood pneumonia as the largest single cause of global childhood mortality, which has led to increased investment and action. Global deaths have reduced from 2.01M (in 2002) to 1.58M (2008) and 1.26M (2011).

Significance: Global child pneumonia mortality (2008–2013) showed about 1M deaths fewer than if 2008 levels had persisted throughout this period.

Attribution: Campbell and Rudan (UoE) derived global pneumonia incidence and mortality estimates as the pneumonia technical experts for the WHO / UNICEF Child Health Epidemiology Reference Group.

Beneficiaries: Young children and families, international agencies, Ministries of Health.

Reach: Global (>170 countries on all continents, especially low- and middle-income countries).

2. Underpinning research (indicative maximum 500 words)

Professor Harry Campbell (Director, Centre for Population Health Sciences, UoE, 1995–present) and Professor Igor Rudan (Research Director, Centre for Population Health Sciences, UoE, 2001–present) have conducted epidemiological research on child pneumonia, publishing over 50 papers. These include estimates of disease burden, pneumonia vaccine immunogenicity, prevalence of risk factors, estimates of effectiveness of interventions, and the WHO pocketbook of Hospital Care for Children (Campbell was overall editor and author of pneumonia chapter).

Campbell and Rudan were founding members and the pneumonia technical experts from 2001 (with Campbell acting as deputy chair 2011–) of the Child Health Epidemiology Reference Group (CHERG), which was established by WHO / UNICEF to conduct research to prepare global child disease burden estimates and advise international agencies and national governments. Campbell and Rudan's subsequent research on pneumonia mortality, under the auspices of CHERG, involved extensive systematic literature review (including in Chinese language databases) and identification of unpublished data sources coupled to interpretation and assembly of routine death certification (vital registration) from every country, and verbal autopsy data from large international surveys. The analysis involved complex statistical modelling of data [3.1, 3.2]. The resultant child pneumonia mortality estimates were published in several Lancet [3.1, 3.3, 3.4] and other [3.5] papers. (Reference 3.3 was the most highly cited paper published in Lancet 2010–12: source Lancet). Thus, CHERG (with pneumonia technical leadership by Campbell and Rudan) detailed the major causes of child death and estimated the magnitude of this burden for > 170 countries over the period 2000 to date.

Using similar methods, Campbell and Rudan also published the first global incidence estimates for childhood pneumonia in 2004 and 2008 [3.3, 3.6].

The high international quality of this research is indicated by Campbell and Rudan publishing 10 Lancet original papers and two commentaries on child pneumonia over the last 10 years.

Most recently, Campbell and Rudan were invited by WHO and UNICEF (as part of their Global Action Plan for the control of Pneumonia and Diarrhoea) to review progress in pneumonia control (2000 to 2013), which was published as a "Lancet series" in 2013. Campbell and Rudan spoke at

the global launch of the series in London and Washington DC.

3. References to the research (indicative maximum of six references)

3.1 Liu L, Johnson H, Cousens S,…Rudan I, Campbell H, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012;379:2151–61. DOI: 10.1016/S0140-6736(12)60560-1.

3.2 Rudan I, Tomaskovic L, Boschi-Pinto C, Campbell H; WHO Child Health Epidemiology Reference Group. Global estimate of the incidence of clinical pneumonia among children under five years of age. Bull World Health Organ. 2004;82:895–903. DOI: 10.1590/S0042-96862004001200005.

3.3 Black R, Cousens S, Johnson H,…Rudan I,…Campbell H, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality in 2008: a systematic analysis. Lancet. 2010;375:1969–87. DOI: 10.1016/S0140-6736(10)60549-1.

3.4 Bryce J, Boschi-Pinto C, Shibuya K, Black R; WHO Child Health Epidemiology Reference Group (including Campbell as pneumonia technical expert). WHO estimates of the causes of death in children. Lancet. 2005;365:1147–52. DOI: 10.1016/S0140-6736(05)71877-8.

3.5 Theodoratou E, Zhang J, Kolcic I,…Rudan I, Campbell H. Estimating pneumonia deaths of post-neonatal children in countries of low or no death certification in 2008. PLoS One. 2011;6:e25095. DOI: 10.1371/journal.pone.0025095.

3.6 Rudan I, Boschi-Pinto C, Biloglav Z, Mulholland K, Campbell H. Epidemiology and etiology of childhood pneumonia. Bull World Health Organ. 2008;86:408–16. DOI: 10.2471/BLT.07.048769.

Key Grants:
Bill and Melinda Gates Foundation (US$1.8M) Modelling the impact of emerging interventions against pneumonia. (Rudan and Campbell co-PIs.)

Bill and Melinda Gates Foundation (US$10M) Child Health Epidemiology Reference Group. (Black, Johns Hopkins University PI; Campbell and Rudan sub-grantees to support their CHERG research.)

4. Details of the impact (indicative maximum 750 words)

Although Campbell and Rudan's work with CHERG showed that pneumonia was the largest single cause of global child mortality in 2008 [3.1], it was receiving considerably less global investment and attention than other conditions such HIV and malaria. Clearly, effective action on global child pneumonia mortality was an essential part of reaching the United Nations Millennium Development Goal 4 set in 2005 by 170 Heads of State to reduce global child mortality by two thirds from 1990–2015. This has been triggered as a direct consequence of Campbell and Rudan's work

The CHERG committee, including Campbell and Rudan as pneumonia technical advisers [5.1] met every 6 months from 2000–2013. WHO and UNICEF attended all meetings; other international agencies (e.g., Save the Children Fund, Global Alliance on Vaccines and Immunisations (GAVI), US Agency for International Development (USAID), Bill and Melinda Gates Foundation) attended when appropriate.

Impact on public policy
Campbell and Rudan have regularly acted as advisers / working group chairs on child pneumonia to WHO (30 occasions since 1993) [5.2], the UK government (All-Party Parliamentary Group for Global Action Against Childhood Pneumonia), UNICEF [5.3] and other international agencies.

CHERG's pneumonia disease estimates were adopted not only by WHO and UNICEF [5.2–5.5] but also by major international agencies (including GAVI, Save the Children Fund and the Bill and Melinda Gates Foundation). Lancet editor Richard Horton (#richardhorton1) tweeted on 24/5/2013 "CHERG has made stellar contributions to our understanding of child health." This recognition has

led directly to increased emphasis and priority given by international agencies and national health systems to tackling this problem. Examples include:

1. Impact on WHO and UNICEF policy, leading to the establishment in 2009 of a Global Action Plan on Pneumonia (GAPP). Campbell and Rudan led the pneumonia overview, published in a Bulletin WHO supplement, which assisted in preparation of the GAPP document [5.6]. This ongoing action plan gives renewed emphasis to pneumonia control. It has led to increased coverage of effective pneumonia interventions, for example through the initiation of community case-management programmes (by community health workers) and the investment in new pneumonia vaccines (see point 2 and [5.7]).

2. Impact on GAVI to give priority to the accelerated global implementation of pneumonia vaccines (Hib and pneumococcal conjugate vaccines). There was a steep acceleration in uptake of Hib conjugate vaccine by low- and middle-income countries from 2007/8 with 50 countries introducing Hib conjugate vaccine into their national vaccination schedules over the period 2008–13. Similarly, the uptake of pneumococcal conjugate vaccine, from its introduction in 2004, accelerated from 2007/8, with more than 50 countries introducing this vaccine from 2008 onwards.

3. Impact on the >190 member states of the World Health Assembly (WHA) (2010). Campbell initiated a UK action to lead a WHA pneumonia resolution (WHA63.24 - Accelerated progress towards achievement of MDG4 to reduce child mortality: prevention and treatment of pneumonia). Campbell met Chief Medical Officer (CMO) Sir Liam Donaldson to propose and help draft the resolution, and was technical consultant to the UK delegation in Geneva in 2010. Ministers of Health, CMOs and other senior health officials from the 170 Member States constituting the WHA endorsed the resolution on the Control of Pneumonia, committing them to adoption of pneumonia control policies and actions and to giving increased priority to this problem [5.8].

Impact on health and welfare

One of the major success stories in international health has been the substantial progress made since 2000 in the reduction of global child mortality. This has fallen from 11 million deaths per year in 2000 to 6.9 million per year in 2012. The largest single cause of death over this period, and the disease showing the largest relative and absolute rate of mortality reduction over the period of REF2014, is child pneumonia [3.1]. There have been approximately 1M fewer child pneumonia deaths over the period 2008–12 than if 2008 mortality levels has persisted. These falls in mortality have occurred in >170 countries, with the main impact in low- and middle-income countries. These estimates have been endorsed in WHO and UNICEF documents [5.4 a & b, 5.5]. WHO and UNICEF consider that the direct action to prevent and treat child pneumonia that has been taken by national governments and international agencies, driven by the clear need and imperative demonstrated by the work of Campbell, Rudan and CHERG, is the major cause of the mortality reduction.

Impact on society

Campbell spoke at the global launch (in New York) of the World Pneumonia Day movement in 2007, which has since grown worldwide [5.9]. In 2011, it included activities in 25 countries worldwide to support pneumonia control efforts. This led to the creation of a Global Coalition Against Child Pneumonia in 2009 comprising over 140 non-governmental organisations, civil society organisations, academic institutions (including UoE) and government agencies [5.9].

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 Letter from Chair of International Health, Johns Hopkins University and chair of CHERG. *[Available on request. Confirms Campbell and Rudan's role in CHERG as technical experts on pneumonia and from 2011 Campbell's role as co-chair of CHERG].*

5.2 Letter from Director of WHO Maternal and Child Health Programme, Geneva. *[Available on request. Confirms Campbell and Rudan's role in CHERG and its influence on WHO global child health policy; role of Campbell and Rudan in Global Action Plans on pneumonia control.]*

5.3 Letter from Head of Health, UNICEF, New York *[Available on request. Confirms Campbell*

and Rudan's role in CHERG and its influence on global health priority-setting by UNICEF.]

5.4 (a) WHO (2009). Global Action Plan for the Prevention and Control of Pneumonia 2009. http://www.unicef.org/media/files/GAPP3_web.pdf;
(b) WHO / UNICEF, 2013, Integrated Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea.
http://apps.who.int/iris/bitstream/10665/79200/1/9789241505239_eng.pdf *[These documents cite and show official endorsement of CHERG estimates.]*

5.5 UNICEF (2006). Pneumonia: the forgotten killer of children.
http://www.childinfo.org/files/Pneumonia_The_Forgotten_Killer_of_Children.pdf *[This UNICEF policy document acknowledges the contribution of Campbell and Rudan and show official endorsement of CHERG estimates; this pre-2008 policy fed into REF-period impact on mortality.]*

5.6 Letter from the Coordinator of the Expanded Programme on Immunization, WHO Department of Immunization, Vaccines and Biologicals, Geneva. *[Available on request. Confirms Campbell and Rudan's role in the establishment of the Global Action Plan on Pneumonia.]*

5.7 International Vaccine Access Centre (2012). IVAC Vaccine Information Management System report 2012 poster. http://www.jhsph.edu/research/centers-and-institutes/ivac/vims/IVAC-VIMS_Report-2012-03.pdf. *[Hib vaccine introduction in 22 countries in 2007, 65 countries in 2011 and >70 (projected) in 2013 – page 7; PCV vaccine introduction in 0 countries in 2007, 18 countries in 2011 and >50 (projected) in 2013 – page 11.]*

5.8 WHO (2010). Sixty-third World Health Assembly, Resolutions and Decisions.
http://apps.who.int/gb/ebwha/pdf_files/WHA63-REC1/WHA63_REC1-en.pdf. *[Endorsement of the resolution on the control of pneumonia, led by Campbell.]*

5.9 World Pneumonia Day (2011). World Pneumonia Day global report 2011
http://worldpneumoniaday.org/wp-content/uploads/2012/04/World-Pneumonia-Day-2011-online.pdf. *[Details achievements including 62 events in 29 countries across 6 continents (including thousands of children receiving free healthcare); 24 local organisations in 14 countries receiving grants; direct targeting of 11 governments; 240 unique news stories in 52 countries.]*