One Health - 'joining the dots'

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Discussion

To achieve the goals of the One Health agenda, multi- and interdisciplinary approaches are essential. It is now common to bring people from different backgrounds together to work on a single disease problem, with a large number of multi-partner consortia currently funded by the European Commission, the European and Developing Countries Clinical Trials Partnership (EDCTP), the Bill and Melinda Gates Foundation and others. Within institutions, mechanisms to increase interactions across disciplines include common seminars, retreats, and the formation of themed virtual centres. Despite the willingness of most scientists to cooperate in research towards a common goal, the existence of different professional cultures has been identified as a barrier in achieving One Health objectives. Cooperation, complementarities and convergence are required to achieve our goals. More effective communication, better teaching to increase awareness of One Health issues and more meetings that bring both animal and human health experts together are needed in order to join the dots across the disciplines in One Health.

A 'One Health' approach to improving human and animal health worldwide is a priority, as about two-thirds of human infectious diseases and about three-quarters of emerging infectious diseases are thought to be zoonoses. In addition, changes to farming methods and to more intensive farming in some parts of the world, together with greater travel and contact with wildlife, all increase the risk of infectious spread from animals to humans. A pertinent example of what can happen when human and animal health agencies do not communicate well is illustrated by the outbreak of Q-fever in the Netherlands (Enserink 2010). Q-fever is caused by *Coxiella burnetti*, an organism that can infect many species but it causes abortions and stillbirths in pregnant goats. In 2007, 182 human cases were diagnosed in the Netherlands, however this increased to 1000 cases in 2008 and 2361 cases in 2009. Due to fears of potential loss of income, the presence of infections in goats had not been communicated to human clinicians. In addition to the burden of human disease that resulted, there were 6 deaths in 2009, and the spread of the infection within intensively farmed goat herds resulted in the decision to cull all pregnant goats in order to control the epidemic. Although it is still unclear whether the epidemic resulted from a particularly virulent strain of *C. burnetti*, or from the high intensity farming of goats in a highly populated country, it is clear that there are both human health and economic risks from such outbreaks.

Multi- and interdisciplinary approaches are required to deal with such zoonotic threats to human health. Environmental factors include the production system in use, host abundance, host species diversity, interactions both within and between species, and selective pressures such as the use of antibiotics (Coker *et al*. 2011). Biological pressures will include both the diversity of the pathogenic species, and its mode and dynamics of transmission. The health impact will also be affected by the transmissibility of the infection, and the risk of disease emergence and spread. Finally there will be economic and social factors that include not just the economic impact of infection but the cultural, environmental and socioeconomic context. Thus Coker and colleagues have advocated that in order to achieve One Health, many disciplines will need to collaborate and work together (Coker *et al*. 2011).

People working on the same disease, or with a common purpose, are usually more than willing to collaborate. A successful example of interdisciplinary collaboration from the London School of Hygiene and Tropical Medicine is that of the Gates Malaria Partnership (n.d.) and its successor, the Malaria Capacity Development Consortium (n.d.), funded by both the Gates Foundation and the Wellcome Trust.

The Gates Malaria Partnership (2001–2009) was able to fund research projects for PhD students and postdoctoral scientists in 14 African countries as well as China, Bolivia and Pakistan, in disciplines ranging from laboratory science to entomology, intervention studies and health economics – yet all these projects became part of a network. The Malaria Capacity Development Consortium (2008–2013) is now continuing the same joined-up approach to research and training in malaria. There are other examples of successful consortia in the tuberculosis field. The European Commission FP6-funded TBVAC Consortium had 32 partners in 9 European and 4

African countries, all united by the common goal of a new vaccine against tuberculosis (TuBerculosis Vaccine Initiative n.d.a). This consortium included the discovery of new antigens, testing in animal models, work on delivery systems and adjuvants, on correlates of protection, and the early steps of testing the new vaccines – thus bringing together scientists with a range of disciplinary backgrounds. Again, successful progress has led to a new consortium, aptly titled NEWTBVAC (TuBerculosis Vaccine Initiative n.d.b), with European Commission FP7 funding, and the establishment of a foundation to facilitate European efforts towards the global development of new TB vaccines, the TuBerculosis Vaccine Initiative (TBVI) (TuBerculosis Vaccine Initiative, n.d.c).

Many other research consortia carry out large multicentre studies, such as the Gates Grand Challenge funded Biomarkers for TB in Africa (Biomarkers for TB n.d.), where cohorts of subjects at 7 African sites have been recruited and followed longitudinally for the development of disease, in order to identify biomarkers that predict the development of, or protection from, disease. Working across different countries can bring additional insights; for example, when BCG vaccinated infants were compared for the immune responses induced three months post BCG vaccination, in the United Kingdom (UK) and Malawi, UK infants were found to have stronger Th1 cytokine responses than Malawian infants (Lalor *et al*. 2009).

However, the use of multiplex bead array assays revealed that the Malawian infants were not merely poor responders – instead they made stronger responses in terms of other Th2 and down-regulatory cytokines, thus illustrating the impact of environment on such immunity (Lalor *et al*. 2011). Sometimes more than one infection can be studied in a consortium, as in the IDEA consortium which is studying the effect of helminth co-infection on immunity against TB, HIV and malaria (IDEA n.d.). On occasion the spectrum of disciplines and backgrounds in such consortia becomes even wider, such as in the Innovative Vector Consortium which combines scientists from academia and from industry (Innovative Vector Consortium n.d.). To be successful, such projects need sufficient funding, good leadership, and regular meetings (preferably at a remote location where all those present have to focus on the business of the meeting).

Partnerships across countries and diseases are also a feature of current capacity building efforts. These include the European and Developing Countries Clinical Trials Network (EDCTP n.d.) with its regional nodes of excellence, and the 7 Wellcome Trust-funded African Institutions Initiative capacity building consortia (Wellcome Trust n.d.). Again, despite different backgrounds and levels of research expertise, such consortia can work together well, sharing experience and identifying new opportunities for collaborative research.

Institutions such as the London School of Hygiene & Tropical Medicine (LSHTM) also have their challenges in maximising the benefit of the breadth of disciplines and infections present within the institution. One approach taken by the LSHTM has been to set up cross-faculty virtual Centres, that can be disease specific (such as the Malaria Centre, or the newer Tuberculosis Centre), or topic specific such as the MARCH Centre that works on maternal, reproductive and child health, linking over 100 researchers who have research interests in some aspect of this topic (London School of Hygiene & Tropical Medicine n.d.). Within the Bloomsbury area of London, a major cross-institution centre has been established, to break down barriers and allow innovative approaches to research and teaching in the area of international development. The London International Development Centre (London International Development Centre n.d.) is a partnership of six colleges situated in the Bloomsbury area – the Royal Veterinary College, Birkbeck College, the School of Pharmacy, the Institute of Education, the School of African and Oriental Studies and the LSHTM. LIDC facilitates the cooperation between LSHTM and the Royal Veterinary College on One Health research and teaching, including the UK support for the Southern African Centre for Infectious Disease Surveillance (SACIDS n.d.).

The outcome of all these linkages and consortia is that scientists, far from working in isolated silos, are becoming so well linked to others in their field that there is a danger that individual research innovation may suffer at the expense of harmonised multicentre studies. Partnerships and consortia are essential if we want to achieve our One Health goals, but these need time, effort and adequate funding, and good management and planning are essential. Together, the partners can make greater progress than they would on their own, but there still needs to be a place for original research ideas (Dockrell 2010).

If consortia and centres that are by definition cross disciplinary can work well, and if institutions can link researchers from different disciplines to work together, this raises the question why a recent publication by Meisser and colleagues (Meisser, Schelling & Zinsstag 2011) identified different professional cultures as the most important barrier to delivering on One Health. Jeff Waage of the London International Development Centre has proposed that in order to make an inter-disciplinary approach to One Health work, *Cooperation* – where working together is necessary to achieve a particular goal, *Complementarity* – where one party benefits from the other's strengths or resources, and *Convergence* – where societal change leads to common tools and agendas, are all needed (J. Waage, pers. comm., n.d.). For example, cooperation is needed on cooperative projects on zoonotic diseases which link veterinary and public health surveillance and management activity. The increasing threat of anti-microbial resistance is one subject that is a clear public health priority and that requires a co-operative approach. Complementarity may sometimes be less obvious, but can usually be found. For example, public health can make use of veterinary health's superior rural delivery systems, whilst public health systems can have superior financing sources and mechanisms that could be exploited by those working in veterinary health. New technologies and tools can also drive convergence, such as with the cassette based point of care

devices and genome sequencing tools that show promise as diagnostic tools for both human and animal infections.

So the challenge for One Health is to identify and overcome the barriers that prevent animal and human health professionals from working together. To forge cooperation, teams need to be built and the barriers that prevent interdisciplinary work broken down. Complementarity could be achieved by educating medical students and veterinary students about each others' activities so that both groups can 'borrow' good ideas. New teaching courses in One Health would facilitate this. And to drive convergence, we need to identify drivers of change and to be proactive, thinking beyond zoonoses. The recent review by Coker *et. al.* (2011) proposes a framework in which research to inform One Health policy can be conducted. What is certain is that more effective communication, better teaching and more meetings that bring both animal and human health experts together are needed in order to join the dots across the disciplines in One Health.

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