



Building bridges to operationalise one health – A Sino-Swedish collaboration to tackle antibiotic resistance



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ABSTRACT

Antibiotic resistance is a complex global health challenge. The recent Global Action Plan on antimicrobial resistance highlights the importance of adopting One Health approaches that can cross traditional disciplinary boundaries. We report on the early experiences of a multisectoral Sino-Swedish research project that aims to address gaps in our current knowledge and seeks to improve the situation through system-wide interventions. Our research project is investigating antibiotic use and resistance in a rural area of China through a combination of epidemiological, health systems and laboratory investigations. We reflect here on the challenges inherent in conducting long distance cross-disciplinary collaborations, having now completed data and sample collection for a baseline situation analysis. In particular, we recognise the importance of investing in aspects such as effective communication, shared conceptual frameworks and leadership. We suggest that our experiences will be instructive to others planning to develop similar international One Health collaborations.

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1. Introduction

It has become evident in recent years that we need to take a holistic approach to understand the complex global health issue of antibiotic resistance. Research efforts led by single disciplines have produced

essential knowledge, but there is a need for a collaborative multisectoral approach that can deepen our understanding of the underlying dynamics – how bacteria, resistance genes and antibiotics are continuously flowing between humans, animals and the environment and how these might be influenced by various factors [1–5].

One Health is the collaborative effort of multiple disciplines – working locally, nationally, and globally – to attain optimal health for people, animals and the environment [6]. In this article we describe a Sino-Swedish One Health research project that addresses gaps in our current knowledge through a cross-disciplinary collaboration, and seeks to improve the situation through system-wide interventions. We also illustrate the early experiences of this project, called ‘The Sino-Swedish Integrated Multisectoral Partnership for Antibiotic Resistance Containment’ (IMPACT), which involves institutions in both China and Sweden. We do this with a view to contributing to the limited discourse so far on cross-country multisectoral collaborations in One Health.

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2. The context for a one health research project in China

China is one of the largest producers and consumers of antibiotics in the world [7] and high levels of resistant bacteria have been isolated in surveillance programmes and research studies [8–13].

The IMPACT research project is being conducted at a time when antibiotic resistance is gaining increasing attention at the highest of political levels globally, as well as in China [14,15]. The Chinese government has increasingly recognised the challenges that antibiotic resistance pose, has started to take actions across many sectors [15] and has released several policies at a national level for human healthcare [14,16]. As Xiao et al. explain, implementation of these policies have included extensive use of targets, production of guidelines and formulary restrictions, improved education, and liability assignment to institutions and even individuals [15]. There have been clear successes in reducing inappropriate antibiotic use in the past few years, but as these policies have largely been focussed on hospital care in urban areas, it is less clear how much of an effect they have had on the situation in rural populations [17,18]. These policies are linked to and embedded within China's huge and complex set of on-going healthcare reforms.

In recent years both the Ministry of Science and Technology (MOST) and Ministry of Agriculture (MOA) have begun to recognise the influence of animal husbandry on environmental ecology, with research funding being allocated to improve basic knowledge and control mechanisms [7]. National surveillance efforts have started for antibiotic resistance in bacteria from animal origins, and for drug residues on farms. The government is developing methods to monitor antibiotic use in agriculture, as well as plans to evaluate the presence of drug residues and resistance elements in the environment more broadly. The current effectiveness of policies for improving antibiotic use in animal husbandry is hindered by the extremely large populations of animals involved, fragmented systems, and the structural changes currently occurring with large scale intensive production rapidly replacing family farms and back-yard production [19,20].

Further challenges to implementation of policies relevant to antibiotic resistance in China include on-going rapid mass urbanisation, a poorly educated ageing rural population, and a lack of microbiology facilities and expertise for standardised culturing and susceptibility testing of bacteria; however, the development of national policies in several sectors, increasing scientific excellence, and rising public concern for food safety all represent opportunities to improve the situation. Furthermore, the structural changes in both human healthcare and agricultural sectors may themselves provide opportunities for improving previous behaviours and practices.

3. Collaborations between China and Sweden

Addressing antibiotic resistance has long featured on the political agenda in Sweden. This is exemplified by the early banning of antibiotics as growth promoters in animal husbandry in 1986, and by the implementation of national collaborative multisectoral policies against antibiotic resistance in 1995 (Strama, the Swedish Strategic Programme Against Antibiotic Resistance) [21]. The Swedish Government and its agencies have made substantial funding available for research projects and other initiatives that address various aspects of antibiotic resistance. This funding has frequently aimed to stimulate and support international collaborations, recognising that antibiotic resistance is a global concern, and one that cannot be managed within a single country [10,18, 22–24].

In 2006, the Chinese and Swedish governments formed a Memorandum of Understanding on several areas within the health sector, and a Plan of Action specifically emphasising cooperation on antibiotic resistance was signed by the Chinese and Swedish health ministers in 2010 [25]. In 2012, a Memorandum of Understanding on agriculture cooperation was signed between the Ministry of Agriculture of China and the Ministry for Rural Affairs in Sweden, supporting enhanced

cooperation and knowledge exchange within the field of antibiotic resistance and use [26].

Projects investigating antibiotic use and resistance in China were launched and reported, identifying high levels of ESBL bacteria in rural settings, gaps in knowledge about antibiotics in rural caregivers and rural doctors, and describing recent trends in antibiotic usage across several provinces [10,18,27]. The political support extended to the National Natural Science Foundation of China (NSFC) and the Swedish Research Council (SRC), who co-hosted a workshop on antibiotic resistance in Beijing in May 2013, and formed a joint funding call for research collaborations between the two countries [28]. We report here on one of the funded projects.

4. IMPACT – purpose and scope

IMPACT is a multisectoral five-year research project that investigates antibiotic use and resistance in a rural area of China using a One Health approach. This project involves institutions in China and Sweden that span several sectors (Table 1). The governmental authorities on both sides participate as scientific partners. Some of the partners have previously collaborated on smaller-scale research projects [10,18,27].

The IMPACT research project consists of epidemiological and health systems investigations, as well as laboratory analyses. It includes four phases: (i) Joint problem formulation around a One Health approach to antibiotic resistance, involving all partner institutions; (ii) A baseline situation analysis in a rural area in China, investigating the present situation of knowledge, attitudes, practices and perceptions on antibiotic use and antibiotic resistance across human, animal and environment sectors; (iii) Design and implementation of a package of multi-faceted context-specific interventions to prevent infections, improve antibiotic use in humans and animals, and limit the spread of resistant bacteria in this rural area; (iv) Evaluation of the interventions through a repeated situation analysis. The research goals of IMPACT are listed in Table 2.

We have chosen to conduct this research in a rural area because it is likely to provide a more defined and stable environment in terms of population than an urban setting would over the duration of the study. In addition, there are household pigs living in close proximity to humans, and there are good local systems in place that can help support development and implementation of interventions. The project includes a secondary care hospital in a nearby town as well as twelve villages (six intervention and six control villages), pragmatically selected from the 73 villages surrounding the central town in the selected district. In total 780 households are included in the investigations. In addition to the households, we are working with village doctors and animal health advisors in the villages, through the support from local Centers for Disease Control and Prevention. The research project will use context-adapted versions of previously used methods, including investigations of commensal microbiota from humans, animals and the environment, as well as clinical bacterial isolates from the secondary care hospital [10,22,29–31]; measurements of antibiotic use for humans and animals at household and village level, and in the secondary care hospital [32,33]; and assessments of the knowledge, attitudes, practices and perceptions of antibiotic prescribers, dispensers and consumers [27, 33].

This is a mixed methods project, and the expected outcomes are both qualitative and quantitative. Examples of measurable outcomes

Table 1
Partner institutions in IMPACT.

China	Sweden
Zhejiang University (PI)	Public Health Agency of Sweden (PI)
China Agricultural University (co-PI)	Karolinska Institutet (co-PI)
Shandong University (co-PI)	Linköping University (co-PI)
Shandong Academy of Agricultural Science	National Food Agency
Shandong Center for Disease Control and Prevention	National Veterinary Institute

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