

WHEN TOO MUCH CLOSENESS GETS DANGEROUS

The increasing interactions between rural and urban areas have induced health benefits in rural areas, slowly shrinking the rural-urban health gap. However, this higher level of interaction, is giving rise to various health risks threatening health advances achieved over the previous decades. Our author describes the particular hazard potentials arising at the rural-urban interface and explains why we can only counter them with an integrated approach.

By Timo Falkenberg

Although rural development has achieved great progress over the past decades, rural-urban health disparities still persist. Key health indicators, including life expectancy as well as infant, child, and maternal mortality, show worse outcomes among rural compared to urban populations. The 2017 World Health Statistics report of the World Health Organization (WHO) highlights that rural populations have lower access to essential infrastructures such as improved sanitation and drinking water, electricity and communication technologies, and lower access to healthcare services. Whilst the rural-urban gap has narrowed in terms of improved sanitation and drinking water over the Millennium Development Goals (MDGs) era, 14 per cent of the rural population are still relying on unimproved water sources, compared to three per cent among the urban population. Similarly, access to essential healthcare services, including antenatal care, reproductive health services, immunisation services as well as diagnosis and treatment of infectious diseases, remains lower among rural communities. Whilst a multitude of economic factors underlie the health disparities between rural and urban communities (income, consumption, wealth, etc.), low access to essential infrastructures and healthcare services are key determinants of these differences.

Although rural-urban health disparities persist, the dichotomy between rural and urban as distinct locations with distinct characteristics has been blurred over the last few decades. Accompanying the decrease in spatial distance and increasing interdependencies between rural and urban are various economic, social and ecological consequences that interact in a complex system to shape the health and well-being of the population. It is now recognised that such health repercussions cannot be addressed by individual disciplines or sectors but require an interdisciplinary holistic perspective. One concept, which is of particular interest at the rural-urban interface is the 'One Health' approach, which recognises the interdependence of human, animal and environmental health, thus calling for inter-sectoral collaboration to optimise the health of all (see Box on page 23).



When cows live closely together with humans, like in Ahmedabad, India.

Photo: Timo Falkenberg

ZOOBOTIC DISEASES – THE PATHOGEN SPILLOVER

Zoonotic diseases, which are transmitted between humans and animals, are a key theme of One Health. According to the US Center for Disease Control (CDC), zoonotic diseases make up six out of ten known infectious diseases and three out of four emerging diseases (recently appearing infections). A great majority of the global epidemics of the past decades, Ebola, Zika, SARS, influenza (bird flu, swine flu, etc.) are of zoonotic origin, while the globalised movement of humans, animals and materials is compounding the risk of pandemic outbreaks. The 'pathogen spillover' (the transfer from animal to human) often occurs from wildlife via livestock to the human population, thus at the rural-urban interface. In rapidly changing environments, where land-use transformations and deforestation meet agricultural intensification, population growth and densification, the level of interaction between animals and humans is increased, posing higher risk of pathogen spillover and disease outbreak. Therefore, it is essential to monitor animal and human health in an integrated surveillance network to enable rapid detection of pathogens affecting livestock and quick deployment of control measures. At global level,

the tripartite of FAO, the World Organisation for Animal Health (OIE) and WHO are operating the Global Early Warning System for Health Threats and Emerging Risks at the Human-Animal-Ecosystem Interface (GLEWS). The three sister organisations pool their data on disease occurrence from their respective channels and jointly monitor, analyse and model trends to send early warning messages to the affected regions. The system monitors six non-zoonotic and 19 zoonotic diseases.

Another disease category strongly influenced by urban transformations and rural-urban interactions is vector-borne diseases. These are diseases that are transmitted by living organisms, including mosquitos, flies, ticks, aquatic snails, as well as rodents, between humans or from animals to humans. Thus, vector-borne diseases can also be zoonotic. One example of such a zoonotic vector-borne disease is West-Nile Fever, where wild birds form the pathogen reservoir and Culex mosquitos transmit the virus into the human and animal population. The complex transmission pathway is influenced by rural-urban dynamics, as agricultural practices, land-use changes and unplanned urbanisation, along with climatic factors, determine the spatial and temporal distribution and abundance of vectors and

reservoirs. Rural-urban migration fuels slum formation in peri-urban areas, which are built with inferior materials, lack access to clean water and sanitation, and are often overcrowded, thus creating breeding sites for mosquitos, rats and other vectors. At the same time, agricultural intensification and land-use changes in rural areas affect the intensity of contact between reservoirs, vectors and humans, increasing transmission, while also driving vectors to seek new (urban) habitats.

ANTIMICROBIAL FLOWS AND RESISTANCE

The challenge of growing antimicrobial resistance (AMR) has been hailed the greatest threat to sustainable development by the WHO and forms a central pillar of the One Health concept. Resistant pathogens cause infections that cannot be treated by common antibiotics but require the use of so-called 'reserve' or 'last-resort' antibiotics. The use of these last-resort antibiotics has been increasing, resulting in multi-drug-resistant strains that cannot be treated. The root cause of the development of AMR is its overuse in agriculture, veterinary and human medicine. Despite increasingly strict regulation (i.e. bans on antibiotic supplemented feed or on preventive antibiotic use), the livestock sector remains the chief user of antibiotics. The types of antibiotics used are similar across animals and humans and it has been well established that resistant pathogens can transfer their resistance gene to other microorganisms.

The food chain represents the traditional rural-urban linkage, where food items produced in rural areas are transported to urban markets and consumed by the urban population, whilst the inputs of production flow from urban to rural areas. Along this rural-urban linkage resistance genes can spread either directly or indirectly. The most direct transmission pathway is via animal products carrying resistant pathogens, which are transported from rural areas to urban consumers. The application of manure in agricultural production forms an indirect pathway, where faeces excreted by livestock, potentially containing antibiotic residues and resistance genes, are applied to fields. Consequently, the food or feed produced may be contaminated with AMR, which is then spread through the food chain to ultimately reach urban consumers.

Antibiotics consumed by animals and humans alike are partially excreted through urine and faeces. Consequently the wastewater system

THE ONE HEALTH APPROACH

One Health is a interdisciplinary approach bringing together the collective knowledge of multiple disciplines, including public health, veterinary medicine, ecology, agricultural science, sociology and economics, to address the issues at the human-animal-environment interface. Although this called for a unified approach to veterinary and human medicine to address zoonotic diseases. Since the international recognition of One Health, the concept has evolved beyond its initial focus on zoonotic diseases, expanding into issues of antimicrobial resistance, urban health and ecosystem health.

Forschungskolleg One Health and Urban Transformation

The Forschungskolleg "One Health and Urban Transformation" is coordinated by the Center For Development Research (ZEF) as well as various other institutes of Bonn University in co-operation with the United Nations University – Department for Environment and Human Security (UNU-EHS), and the University of Applied Science Bonn Rhein-Sieg (HBRS), all in Germany. The graduate school has 13 doctoral students from different disciplinary backgrounds, each conducting her or his research in one of the four research areas Ahmedabad/India, Accra/Ghana, São Paulo/Brazil and Ruhr Metropolis/Germany.

In the context of Ahmedabad, the Forschungskolleg investigates the spread of antimicrobial resistant bacteria, namely Methicillin-resistant *Staphylococcus aureus* (MRSA), between animals, humans and the environment. The MRSA is commonly associated with hospital-acquired infections. However, community-acquired MRSA is becoming more prevalent. As *S. aureus* can be zoonotic, the study investigates the transmission of MRSA from cows and buffalos into the human population, considering three pathways: direct contact, via shared surfaces, via milk products.

These transmission pathways are mediated by individual (and community) hygiene behaviour as well as food safety regulations.

plays an important role in the spread of AMR. Water is an important rural-urban linkage, as contaminations flow along waterways, giving rise to classical upstream-downstream relations. Even modern wastewater treatment plants cannot fully remove resistant genes, leading to their inevitable release into surface

water. Hence urban antibiotic consumption (as medication and via the food chain) results in higher concentrations of resistance genes in the water system, therefore spreading resistance from urban to rural areas. This is of particular concern, as surface water forms a chief irrigation water source, thus potentially contaminating food and feed crops, which further amplify the development of AMR through the spread via the food chain.

WHAT DOES THIS MEAN FOR HEALTH POLICIES?

As described above, despite the great advances in rural development and the shrinking rural-urban health gap, rural areas remain underserved. In light of Sustainable Development Goal 3, "Good Health and Well-Being", it is important to create incentives for doctors, nurses and other skilled health staff to come to rural areas, as well for attracting investment from insurance companies, private providers and pharmaceutical companies to promote rural healthcare. Here, digital solutions can also help to bridge the rural-urban divide. In India, for example, an app-based clinical decision support tool was developed to support accredited social health care activists (ASHAs) in identifying and managing a wider range of diseases. As a result, fewer visits to healthcare facilities were required, saving time and resources for the individuals and easing pressure on the overcrowded facilities. At the same time, the specific health and development challenges arising from the growing convergence of urban and rural life need to be addressed. The pressure exerted on rural lands by urbanisation and population growth, which is intensifying rural-urban flows, is most evident in peri-urban areas. Research towards understanding the transmission of AMR, identifying critical control points and developing interventions to reduce antimicrobial use are being prioritised at international level. However, continued political commitment (provision of financial resources and engagement in inter-sectoral collaboration), public-private partnerships (for the sustainable implementation of 'One Health') and public engagement (in development and implementation of initiatives), as well as further research are required to develop effective policies and interventions.

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