Population surveillance of cardiovascular diseases in low-income to middle-income countries should leverage existing international collaborations

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Commentary

Population surveillance of cardiovascular diseases in low-income to middle-income countries should leverage existing international collaborations

Justin B. Echouffo-Tcheugui, Sanni Yaya, Rohina Joshi, K. M. Venkat Narayan, Andre Pascal Kengne

INTRODUCTION

Non-communicable diseases (NCDs), especially cardiovascular diseases (CVDs), are the leading cause of death globally, with approximately 80% of NCD-related deaths occurring in low-income and middle-income countries (LMICs). NCDs disproportionately affect individuals in LMICs. Consequently, it is imperative to set up viable disease surveillance systems to accurately assess the burden of NCDs in these countries and design appropriate management and prevention strategies. Public health surveillance is the systematic and continuous tracking of population-level health status, events, outcomes, risk factors and other determinants through the collection, integration, analysis and interpretation of data and the timely dissemination of the information to instigate action. Surveillance is pivotal in public health by providing useful information for policy and decision-making regarding population-level or individual-level preventive, curative or palliative interventions, and is relevant for healthcare providers and consumers.

Although surveillance was originally geared towards controlling infectious diseases, its basic conceptual definition has been extended to chronic NCDs, and CVD in particular. Indeed, CVD surveillance is still a developing field worldwide, especially in LMICs, compared with infectious diseases. Most LMICs are yet to develop the best strategies and tools for monitoring the changing patterns of diseases and the effects of potential interventions. A strategic use of existing international frameworks by these countries has potential advantages as against setting up country-specific systems. Several of such international frameworks exist; examples include the WHO STEPewise approach to Surveillance (STEPS), Monitoring and Evaluation to Assess and Use Results Demographic and Health Surveys (MEASURE DHS) project, Global Tobacco Surveillance System, INDEPTH Network, Living Standards Measurement Study, Global School-based Student Health Survey, Survey of ageing and health, and the Global Burden of Disease project. The
significance of using these frameworks in CVD surveillance includes cross-country learning, resources and expertise sharing, and performance. These frameworks are described in detail in table 1. The details on the components of the STEPS survey components, including the stroke survey, are provided in online supplementary tables 1 and 2. Additional details on the elements assessed in the DHS are also shown in online supplementary table 3.

The cost of implementing population surveillance in LMICs is a major challenge to the overall national and multicountry health systems. Because of budgetary constraints in LMICs, health departments are suboptimally funded to undertake surveillance. In an ideal situation, national governments would allocate resources to the health sector in general and specifically to NCD surveillance. However, achieving appropriate NCD surveillance may require resource mobilisation from international donor agencies to develop a functional surveillance system and provide funds for consistent implementation and further planning of outreach activities. Subnational-level NCD funding mechanisms may also be needed to strengthen surveillance efforts."
Table 1  Overview of major existing international frameworks relevant for non-communicable chronic diseases surveillance in low-income and middle-income countries

<table>
<thead>
<tr>
<th>Surveillance framework</th>
<th>Year available</th>
<th>Country/Region covered</th>
<th>Accessibility</th>
<th>Strength</th>
<th>Limitation</th>
<th>information included</th>
<th>Further description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The WHO STEPwise approach to Surveillance (STEPS)</td>
<td>2005</td>
<td>African, North and South America, South-East Asia, European, Eastern Mediterranean and Western Pacific</td>
<td><a href="http://www.who.int/ncd_surveillance/en/steps_framework_dec03.pdf">http://www.who.int/ncd_surveillance/en/steps_framework_dec03.pdf</a></td>
<td>This allows for the development of an increasingly comprehensive and complex surveillance system depending on resources and local needs. STEPS data are being used to inform NCD policies and track risk factor trends.</td>
<td>The STEPS surveys are conventionally household-based and interviewer-administered and falls short of institutional data.</td>
<td>It is based on sequential levels of surveillance of different aspects of NCDs, allowing flexibility and integration at each step by maintaining standardised questionnaires and protocols to ensure comparability over time and across locations.</td>
<td>The STEPwise approach to risk factor surveillance is implemented through STEPS instruments, which cover three different levels of 'steps' of risk factor assessment, including (1) a questionnaire, (2) physical assessments and (3) biochemical measurements.</td>
</tr>
<tr>
<td>The MEASURE Demographic Health Surveys (DHS) project</td>
<td>1984</td>
<td>Global</td>
<td><a href="https://dhsprogram.com/what-we-do/survey-Types/dhs.cfm">https://dhsprogram.com/what-we-do/survey-Types/dhs.cfm</a></td>
<td>It collects comparable population-based data on fertility, contraception, maternal and child health and nutrition. DHS data have expanded considerably, with new questions and modules on behaviours such as alcohol consumption, tobacco use and other biomarkers.</td>
<td>The DHS is proposed to take place once every 5 years. However, several countries have surveys at irregular intervals. More so, the high traditional focus on children and women is a limitation for its use for surveillance.</td>
<td>Many countries including the poorest have conducted at least one DHS survey. For instance, of the 236 DHS conducted between 1985 and 2010, 49% were in Sub-Saharan Africa, 20% in Asia and 18% in Latin America and Caribbean.</td>
<td>There is an opportunity to use the DHS platform for acquiring data for NCD surveillance (as a by-product), an approach already been used in some countries. For example, the 2002 DHS survey in Uzbekistan measured blood pressure and levels of other common CVD risk factors, including biological markers, and was subsequently used to describe their epidemiology in the country.</td>
</tr>
<tr>
<td>The Global Tobacco Surveillance System (GTSS)</td>
<td>1999</td>
<td>Global</td>
<td><a href="https://www.cdc.gov/tobacco/global/gtss/index.htm">https://www.cdc.gov/tobacco/global/gtss/index.htm</a></td>
<td>The GTSS aims to enhance country capacity to design, implement and evaluate tobacco control interventions, and monitor key initiatives of the WHO Framework Convention on Tobacco Control and components of the WHO MPOWER technical package.</td>
<td>The first Global Youth Tobacco Survey (GYTS) was conducted in 1999. Since then, other comparative reports, based on data from an increasing number of countries, have been made available. However, this has not addressed the misuse of tobacco products.</td>
<td>The GTSS is the largest public health surveillance system ever developed and maintained. The GTSS includes four surveys: the GYTS; the Global School Personnel Survey (GSPS); the Global Health Professions Student Survey (GHPSS); and the Global Adult Tobacco Survey (GATS). The GYTS focuses on youth aged 13–15, and collects information in schools. The GSPS surveys teachers and administrators from the same schools that participate in the GYTS. The GHPSS focuses on third-year students pursuing degrees in dentistry, medicine, nursing and pharmacy. The GATS is a nationally representative household survey that monitors tobacco use among people aged 15 years and older.</td>
<td></td>
</tr>
<tr>
<td>The INDEPTH Network</td>
<td>1998</td>
<td>Global</td>
<td><a href="http://www.indepth-network.org/">http://www.indepth-network.org/</a></td>
<td>INDEPTH strengthens global capacity for Health and Demographic Surveillance Systems (HDSS), and mount multidisciplinary research to guide health priorities and policies based on scientific evidence.</td>
<td>There is a limited potential to monitor non-fatal NCDs-related health outcomes across INDEPTH sites.</td>
<td>The network comprised 48 HDSS sites operated by 40 centres in 20 countries across participating continents where about 3.2 million people were studied over time. The focus of INDEPTH on mortality is a huge asset for monitoring the contribution of CVD to overall mortality. The extent of data collection on NCD determinants also varies significantly across INDEPTH sites. While it is inexistent in some centres, few others have evolved with time into community-based laboratories for studying and monitoring NCDs.</td>
<td>Continued</td>
</tr>
<tr>
<td>Surveillance framework</td>
<td>Year available</td>
<td>Country/Region covered</td>
<td>Accessibility</td>
<td>Strength</td>
<td>Limitation</td>
<td>Information included</td>
<td>Further description</td>
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<tr>
<td>Living Standards Measurement Study (LSMS)</td>
<td>1980s</td>
<td>Global</td>
<td><a href="http://surveys.worldbank.org/lsms">http://surveys.worldbank.org/lsms</a></td>
<td>It collects household data useful to assess household welfare, understand household behaviour and evaluate the effect of various government policies on the living conditions of the population.</td>
<td>The LSMS use complex multiple survey instruments to obtain data to ensure high-quality relevant data.</td>
<td>The health module has been expanded to incorporate questions on depression in order to measure its incidence and identify its links with other aspects of welfare and labour market participation.</td>
<td>A potential utility of the LSMS survey in informing NCD research and surveillance is supported by the LSMS working paper number 131 on chronic illness and retirement in Jamaica.</td>
</tr>
<tr>
<td>Survey of ageing and health</td>
<td>2004</td>
<td>Global</td>
<td><a href="http://www.who.int/healthinfo/sage/en/">http://www.who.int/healthinfo/sage/en/</a></td>
<td>SAGE is a source of valuable information on the distribution of risk factors and health inequalities across participating countries.</td>
<td>SAGE is limited to chronic diseases and risk factors.</td>
<td>The WHO Study on global AGEing and adult Health (SAGE) is an ongoing initiative by the WHO to compile longitudinal information on the health and well-being of adult populations and the ageing process.</td>
<td>The core SAGE collects data on adults aged 50 years and older, including a smaller comparison sample of younger adults aged 18–49 years, from nationally representative samples. There are eight health and demographic surveillance sites in Bangladesh, Ghana, India, Indonesia, Kenya, South Africa, Tanzania and Vietnam, with an additional combined sample size of over 45 000 people as part of SAGE.</td>
</tr>
<tr>
<td>The Global School-based Student Health Survey (GSHS)</td>
<td>2003</td>
<td>Global</td>
<td><a href="http://www.who.int/ncds/surveillance/gshs/en/">http://www.who.int/ncds/surveillance/gshs/en/</a></td>
<td>The GSHS is a relatively low-cost, school-based survey which uses a self-administered questionnaire to obtain data on young people’s health behaviour and protective factors related to the leading causes of morbidity and mortality among children and adults.</td>
<td>The GSHS examines cardiovascular risk factors and is restricted to children and adolescents.</td>
<td>This is the largest surveillance enterprise worldwide examining cardiovascular risk factors among children/adolescents. The GSHS has contributed important data on the distribution of CVD risk factors (obesity, physical activity, tobacco use and dietary intake) and their clustering among adolescents in LMICs. The specificity of this surveillance endeavour is that it includes important data on lifestyle factors, namely physical activity and dietary intake.</td>
<td>The GSHS measures and assesses the behavioural risk factors and protective factors in 10 key areas (alcohol use, dietary behaviours, drug use, hygiene, mental health, physical activity, protective factors, sexual behaviours, tobacco use, violence and unintentional injury) among adolescents.</td>
</tr>
</tbody>
</table>
Table 2 Cluster risk factors and determinants of preventable non-communicable chronic diseases

<table>
<thead>
<tr>
<th>Preventable chronic disease and conditions</th>
<th>Biological risk factors/markers</th>
<th>Risk and protective factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischaemic heart disease.</td>
<td>Obesity.</td>
<td>Behavioural factors</td>
</tr>
<tr>
<td>Type 2 diabetes.</td>
<td>Dyslipidaemia.</td>
<td>► Physical activity.</td>
</tr>
<tr>
<td>Renal disease.</td>
<td>Impaired glucose regulation.</td>
<td>► Smoking.</td>
</tr>
<tr>
<td></td>
<td>Proteinuria.</td>
<td>► Alcohol misuse.</td>
</tr>
</tbody>
</table>

Non-modifiable factors: age, sex, ethnicity, genetic make-up and family history.
Socioenvironmental determinants (may or may not be modifiable): socioeconomic status, community characteristics (eg, presence/absence of social capital), work conditions, environmental health and so on.

been developed to monitor the health of populations in the context of their residential communities, involving a complex interaction of health determinants, health outcomes, physical measurements, biological samples, policies and the built environment.26

Population-based data are essential to surveillance and provide valuable information for planning and evaluating disease prevention and control strategies.2 However, data sources for NCD surveillance may vary substantially, including a notifiable diseases system, vital statistics, sentinel surveillance, registries, health surveys, administrative data collection systems and census (table 3). The nature of diseases renders some data gathering systems less attractive. Indeed, the aspects of NCD most amenable to public health interventions are risk factors for the disease and present years before the disease becomes evident. Furthermore, some risk factors for diseases and related complications simply do not operate at the individual level, and there are future issues for planning related to comorbidity.1

THE FUTURE OF NCD SURVEILLANCE AND THE POTENTIAL CONTRIBUTION OF TECHNOLOGY

The use of technology may potentially help in improving disease surveillance. Electronic health records can
### Table 3  Scope and potential sources of data required for chronic disease surveillance

<table>
<thead>
<tr>
<th>Determinants</th>
<th>Preclinical</th>
<th>Clinical</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data examples</strong></td>
<td><strong>Data examples</strong></td>
<td><strong>Data examples</strong></td>
<td><strong>Data examples</strong></td>
</tr>
<tr>
<td>Genetics</td>
<td>Screening</td>
<td>Diagnosis</td>
<td>Mortality</td>
</tr>
<tr>
<td></td>
<td>Blood lipids.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk behaviour</td>
<td>Risk reduction</td>
<td>Treatment and procedures</td>
<td>Morbidity</td>
</tr>
<tr>
<td>Environment</td>
<td>Service use</td>
<td>Pharmaceutical</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physician visits.</td>
<td>Complications and interactions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home care.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ambulatory care.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Palliative care.</td>
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</tbody>
</table>

facilitate the extraction of information from medical files, which implies that hospital-based data could be used for surveillance, but not without practical challenges in majority of LMICs. However, recent initiatives such as the Data for Health initiative, a partnership between the CDC, the CDC Foundation, Bloomberg Philanthropies and other organisations, are geared towards support for surveillance in 20 LMICs across Latin America, Asia and Africa. The partnership will also strengthen birth and death registration systems and improve information on the aetiology of death to bolster policy development. The initiative will provide experts to create mobile phone risk factor surveys for NCDs. Finally, the partnership will help inculcate, CDC-supported Field Epidemiology Training Program residents and National Public Health Institute staff to use health data to inform policy development. The Bloomberg Mobile Phone Risk Factor Surveys for Non-communicable Diseases will implement a mobile survey to track CVD data in the selected countries. The project will test the feasibility of using mobile phones to collect data that can supplement household surveys for non-communicable chronic diseases (such as heart attacks, stroke and diabetes), injuries and environmental health factors. The potential limitations of such an undertaking include limited clinical information and diagnostic misclassification such as underdiagnosis, overdiagnosis and misdiagnosis common with cardiovascular and chronic lung diseases.

Whether social networking, as suggested in other parts of the world (e.g., USA), has the potential to modify the future of surveillance in LMICs remains unclear. The integration of social networking in surveillance would be challenging, as this requires access to the internet, which may not be commonplace in many parts of the LMICs.

**LEVERAGING THE EXISTING RESOURCES IN LMICS FOR CVD SURVEILLANCE AND BUILDING ON EXPERIENCES FROM OTHER PARTS OF THE WORLD**

The scope of data needed for NCD surveillance is very broad, and no single data gathering system is able to provide the mix of data required for a comprehensive surveillance.\(^1\)\(^2\)\(^7\) Hence, population-based data collection requires multiple sources, including a notifiable disease system, vital statistics, disease registries, health surveys, censuses and sentinel surveillance.\(^12\)\(^27\) This mix of data feeds is lacking in LMICs, which largely have yet to build the basic blocks for an ongoing NCD surveillance system. Setting up and maintaining a surveillance system require substantial investments in terms of human skills, time and financial resources. Consideration for sources of funding to establish a sustainable surveillance system includes local governments, international public agencies (such as the US Agency for International Development, WHO and CDC), and other dedicated research funding institutions such as the Wellcome Trust, the National Institute of Health and the Medical Research Council.

The level of investments required to achieve a comprehensive surveillance can quickly become prohibitive,
particularly when there is a lack of a baseline framework to build on. It is therefore important for LMICs to make strategic decisions in terms of the scope of their surveillance data needs and possible pathways for making such data available, while accounting for the downstream challenges to process and convert the data collected into outputs that will efficiently inform action. Whenever there are existing opportunities within countries for regular contact with the population, which can be capitalised on to gather surveillance data, building on such an opportunity is likely more feasible and cost-effective than setting up a completely new system. Where countries are contemplating starting new data gathering systems, there are advantages in adapting existing international frameworks as opposed to setting up a country-specific system. Such advantages include cross-country learning, resources and expertise sharing, and performance comparisons. Creating a reliable global NCD surveillance interconnected system would greatly contribute to reaching the United Nation - NCDs 2025 nine global targets/goals, through evaluation of the extent of what would remain to be done in that direction. This is also true for the 2030–2040 Sustainable Development Goals, especially goal 3, which pertains to ensuring healthy lives and promoting well-being for all at all ages.

CONCLUSION
In brief, LMICs are still to develop the best approach to surveillance of NCDs. This will require the appropriate investment, which can involve developing new initiative but also leverage existing international framework to limit costs. Such an undertaking is not devoid of challenges. Given the important human and financial burden of NCD in LMICs, an effective surveillance system would greatly contribute to limiting the costs related to these conditions.

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Contributors The authors contributed equally to this work.

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