Ten years of the WHO STEPwise approach to chronic disease risk factor surveillance (STEPS): Challenges and opportunities

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INTRODUCTION

The burden of chronic, noncommunicable diseases (NCDs) is increasing rapidly and will have significant social, economic and health consequences unless it is urgently addressed. Evidence of this increasing burden in low and middle income countries is now very clear. In 2005, the major chronic NCDs accounted for 60% of all deaths and 47% of the global burden of disease. By 2020 these figures are expected to rise to 73% and 60% respectively. 80% of chronic disease deaths are already occurring in low and middle income countries (World Health Organization, 2005 (1)). Since NCDs are largely preventable, these premature deaths can be significantly reduced. The key to controlling the global epidemic of chronic diseases is primary prevention based on comprehensive population-wide programmes. Effective prevention of chronic NCDs is possible through identification of the major common risk factors and their prevention and control.

Common, preventable risk factors underlie most chronic diseases. These chronic disease risk factors are the leading cause of the death and disability burden in all countries, regardless of their economic development status. The leading behavioural and biological risk factors for chronic diseases are tobacco use, harmful alcohol consumption, low fruit and vegetable consumption, physical inactivity, overweight and obesity, raised blood pressure, raised blood glucose and abnormal blood lipids (World Health Organization, 2002).

Recognizing a global need for chronic disease risk factor data on these key NCD risk factors, in 2000 WHO initiated the STEPwise approach to surveillance (STEPS). STEPS was designed to assist Member States with surveillance of these eight key risk factors for the major NCDs, and strengthen capacity in low and middle income countries for chronic
disease risk factor surveillance. The key goals of STEPS are: to guide the establishment of risk factor surveillance systems in countries by providing a framework and approach; to strengthen the availability of data to help countries inform, monitor and evaluate their policies and programs; to facilitate the development of population profiles of NCD risk factors; to enable comparability across populations and across time frames; and to build human and institutional capacity for surveillance.

Since cause specific mortality data related to NCDs from low and middle income countries are largely unavailable, STEPS data helps countries identify the risk profile of their populations which serve as a pointer to future NCD epidemics. Even in countries with good mortality data, risk factor profiles help guide upstream interventions.

Since its inception in 2000, the STEPwise approach has advocated that small amounts of good quality data are more valuable than large amounts of poor quality data (Armstrong and Bonita, 2003). The STEPS approach supports monitoring a few modifiable NCD risk factors which reflect a large part of the future NCD burden; and which can indicate the potential success of interventions considered to be effective in reducing the leading NCDs. Since STEPS also promotes the collection of data on a number of different risk factors, it has the benefit over single-issue surveys in that it allows for an understanding of how risk factors cluster within a population.

The objective of this paper is to describe the development and current status of STEPS, present some STEPS data examples and to discuss the strengths and limitations of STEPS surveillance and future directions.

**METHODS**

**The STEPS framework and basic concept**

The STEPS framework is based on the concept that surveillance systems require standardized data collection, but also sufficient flexibility in order to be appropriate in a variety of country situations and settings (Armstrong and Bonita, 2003). The key element
of this framework is the distinction between different levels of risk factor assessment which allow greater or lesser levels of detail, depending on the resources available, without compromising the comparability of the data. In Step 1, information on demographics and behavioural risk factors (tobacco use, alcohol consumption, fruit and vegetable intake, physical inactivity, as well as history of raised blood pressure and diabetes) is collected through self-report. Physical measurements of height and weight in order to measure the Body Mass Index (BMI), waist circumference and blood pressure are undertaken in Step 2, and Step 3 consists of biochemical measurements of fasting blood glucose and total cholesterol levels. Within each Step, the "core" items have been identified as those which will enable the collection of the most essential information on each risk factor. Additionally, "expanded" items are available for those countries desiring more nuanced information on any of the risk factors, resources permitting. Expanded items include additional information on each of the behavioural risk factors of Step 1, measurement of hip circumference and heart rate in Step 2, as well as biochemical assessment of triglycerides and HDL cholesterol levels in Step 3. The PanAmerican version of the STEPS questionnaire also includes expanded questions on family history of NCDs and preventive health practices, e.g. the participation in screenings and regular check-ups. Finally, standardized "optional" modules have been developed in collaboration with the respective technical departments in WHO and topic area experts in violence and injury, oral health, and sexual and reproductive health.

**STEPS sampling**

The basis of STEPS risk factor surveillance is repeated cross-sectional, population-based household surveys (World Health Organization, 2005 (2)). Multi-stage cluster sampling is used in most countries to draw a nationally or sub nationally representative sample. Exceptionally, there are a few very small and/or well-resourced countries that have performed simple random sampling or censuses.

**Coordination and technical support from WHO**

Coordination and technical support for the implementation of STEPS are provided across WHO headquarters, Regional and Country Offices, and in collaboration with partners
such as the Caribbean Epidemiology Center (PAHO-CAREC). In order to provide overall guidance on the planning and implementation of STEPS, STEPS training workshops are delivered at different stages of the surveillance process: implementation, data collection, data analysis and reporting, as well as data utilization.

For each of these stages, survey tools and training materials are available. They include, for example, the STEPS Manual and CD (updated along with the STEPS Instrument in 2008); templates for an implementation plan and ethical approval; sampling tools, such as a sample size calculator and a sampling spreadsheet; various forms for data collection; as well as analysis programs for several statistical packages and reporting templates (STEPS website).

**Latest technological developments**

eSTEPS, a suite of software that allows for the preparation and implementation of data collection using Personal Digital Assistants (PDAs), has been put into wide use in 2009, following five years of piloting and development. This method of data collection is a significant improvement on the previous paper-based method in that it:

- allows for automatic skip patterns to be programmed into the questionnaire;
- performs immediate error-checking;
- provides a simplified and documented means of selecting participants from within each selected household;
- requires no data entry work following data collection.

With the introduction of eSTEPS, countries have been able to not only improve the quality of their data but also substantially reduce the time from data collection to production of the final report. eSTEPS can be adapted to suit any survey and has thus far been implemented in English, French, Spanish, Arabic, Mongolian (Cyrillic), and Khmer.
RESULTS

Status of STEPS Implementation
After STEPS had been initialized in 2000 and several regional workshops had been conducted, the first countries started implementing this system in 2002 and 2003 (Armstrong and Bonita, 2003).

By 2005, 56 countries from 4 regions had attended 17 regional and/or national workshops, and 48 countries (14 AFR, 1 AMR, 11 EMR, 9 SEAR, 13 WPR), including three that aligned STEPS to their national risk factor studies, had, by the end of that year, completed data collection (Figure 1). Of these surveys, 26 were national.

To date, 114 countries from 5 regions have attended a total of 67 regional and/or national workshops, and 85 countries (31 AFR, 9 AMR, 15 EMR, 10 SEAR, 20 WPR) have completed data collection (Figure 1), including 7 STEPS aligned surveys. In total, 54 countries have carried out national surveys. A total of twenty countries have already undertaken more than one STEPS or STEPS aligned survey.
Activities in the past two years

Since 2008, 55 countries have received technical support through STEPS workshops. For 17 of these countries, this support focused on the stages before data collection (implementation, planning and data collection training), while the support focused on the stages after data collection (data analysis and reporting, data to policy training) for 33 of
these countries. A total of 5 countries received support for both the stages before and after data collection.

During this time period, 22 countries have completed data collection, including 12 new countries. Data were collected with handheld PDAs (eSTEPS) in the British Virgin Islands, Guinea, Libyan Arab Jamahiriya, Malawi, Mongolia and Sierra Leone. Cambodia and the Gambia are currently in the field with eSTEPS.

**Selected results from STEPS surveys**

At the time when STEPS was first introduced, the WHO African region was the region with the least data on chronic disease risk factors and the weakest capacity in this type of epidemiological surveillance. For this article, this region has therefore been chosen to serve as an example for the presentation of results from STEPS surveys. In our analysis, we have included 21 African countries that collected data between 2003 and 2010 using the standardized assessment of tobacco smoking, consumption of fruits and vegetables, physical activity, height and weight, as well as blood pressure. Eleven of these countries included in the analysis conducted national STEPS surveys (table 1). The age range varied by country. In this paper however, we restricted our analysis to those aged 25 to 64. Analytical sample size ranged from 322 (Chad) to 6,511 (Benin), the percentage of original sample size being lower than 50% for Chad, Eritrea, Madagascar, Mali and Sierra Leone (table 1).
Table 1. Coverage, survey year, age range and sample size, STEPS surveys in the WHO African Region, 2003-2009.

<table>
<thead>
<tr>
<th>Country</th>
<th>Coverage</th>
<th>Subnational Region</th>
<th>Survey Year</th>
<th>Age Range</th>
<th>Original Sample Size</th>
<th>Analytical Sample Size ++ (% of original)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>S</td>
<td>Sétif and Mostaganem Wilayas</td>
<td>2003</td>
<td>25-64</td>
<td>4,097</td>
<td>3,820 (93.2)</td>
</tr>
<tr>
<td>Benin</td>
<td>N</td>
<td></td>
<td>2008</td>
<td>25-64</td>
<td>6,842</td>
<td>6,511 (95.2)</td>
</tr>
<tr>
<td>Botswana*</td>
<td>N</td>
<td></td>
<td>2007</td>
<td>25-64</td>
<td>4,003</td>
<td>2,820 (70.4)</td>
</tr>
<tr>
<td>Cape Verde*</td>
<td>N</td>
<td></td>
<td>2007</td>
<td>25-64</td>
<td>1,760</td>
<td>1,596 (90.7)</td>
</tr>
<tr>
<td>Chad</td>
<td>S</td>
<td>N'Djameña</td>
<td>2008</td>
<td>25-64</td>
<td>1,971</td>
<td>322 (16.3)</td>
</tr>
<tr>
<td>Côte d'Ivoire</td>
<td>S</td>
<td>Health regions of Abidjan and surrounds</td>
<td>2005</td>
<td>15-64</td>
<td>4,742</td>
<td>2,548 (53.7)</td>
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<tr>
<td>Democratic Republic of the Congo</td>
<td>S</td>
<td>Ville-Province de Kinshasa</td>
<td>2005</td>
<td>15+</td>
<td>1,943</td>
<td>1,123 (57.8)</td>
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<tr>
<td>Eritrea</td>
<td>N</td>
<td></td>
<td>2004</td>
<td>15-64</td>
<td>2,319</td>
<td>620 (26.7)</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>S</td>
<td>Addis Ababa</td>
<td>2006</td>
<td>25-64</td>
<td>4,002</td>
<td>3,766 (94.1)</td>
</tr>
<tr>
<td>Gabon</td>
<td>S</td>
<td>Libreville and Owendo</td>
<td>2009</td>
<td>15-64</td>
<td>2,691</td>
<td>1,807 (67.1)</td>
</tr>
<tr>
<td>Madagascar</td>
<td>S</td>
<td>Antananarivo and Toliara</td>
<td>2005</td>
<td>25-64</td>
<td>5,626</td>
<td>1,618 (28.8)</td>
</tr>
<tr>
<td>Malawi*</td>
<td>N</td>
<td></td>
<td>2009</td>
<td>25-64</td>
<td>5,206</td>
<td>2,842 (54.6)</td>
</tr>
<tr>
<td>Mali</td>
<td>S</td>
<td>Bamako, Kati Central, and Ouéléssebougou</td>
<td>2007</td>
<td>15-64</td>
<td>2,693</td>
<td>711 (26.4)</td>
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<td>Mozambique</td>
<td>N</td>
<td></td>
<td>2005</td>
<td>25-64</td>
<td>3,310</td>
<td>2,641 (79.8)</td>
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<td>Niger</td>
<td>N</td>
<td></td>
<td>2007</td>
<td>15-64</td>
<td>2,757</td>
<td>1,693 (61.4)</td>
</tr>
<tr>
<td>Sao Tome and Principe*</td>
<td>N</td>
<td></td>
<td>2009</td>
<td>25-64</td>
<td>2,457</td>
<td>1,957 (79.6)</td>
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<tr>
<td>Seychelles*</td>
<td>N</td>
<td></td>
<td>2004</td>
<td>25-64</td>
<td>1,255</td>
<td>1,252 (99.8)</td>
</tr>
<tr>
<td>Sierra Leone*</td>
<td>N</td>
<td></td>
<td>2009</td>
<td>25-65</td>
<td>4,997</td>
<td>1,892 (37.9)</td>
</tr>
<tr>
<td>Swaziland*</td>
<td>N</td>
<td></td>
<td>2007</td>
<td>25-64</td>
<td>1,288</td>
<td>1,069 (83.0)</td>
</tr>
<tr>
<td>Zambia</td>
<td>S</td>
<td>Lusaka</td>
<td>2008</td>
<td>25+</td>
<td>1,912</td>
<td>1,254 (65.6)</td>
</tr>
</tbody>
</table>

* = weighted data was available and used in this analysis
+ = N=National, S=Subnational
++ = Analytical sample size includes participants aged 25-64 years only and with valid responses for all 5 risk factors of interest.
Figure 2 shows results for a combination of five risk factors (smoking, low fruit and vegetable consumption, low levels of physical activity, overweight and raised blood pressure). The percentage of the population with 0 of these risk factors was very low and ranged from 0.0 (Ethiopia) to 11.0% (Benin). For all countries, large proportions had one or two of the five specified risk factors. In Algeria, Botswana, Gabon, Mali, Seychelles and Swaziland, more than 30% of the population had between three and five of the five risk factors (figure 2).

**Figure 2. Percentage of the population with 0 (green), 1-2 (orange) or 3-5 (red) of 5 selected risk factors**

+ The 5 risk factors included in analysis were: daily smoking, consuming less than 5 servings of fruit & vegetables on average per day, low levels of physical activity (<600 MET-minutes/week or equivalent), BMI $\geq 25$ kg/m$^2$, and raised blood pressure (SBP $\geq 140$ and/or DBP $\geq 90$ or on medication for raised blood pressure).
DISCUSSION

Progress and strengths
In the decade now since STEPS was originally started in a few low and middle income countries, great progress has been made in generating new country specific risk factor data. This is evidenced by the number of countries who have adopted STEPS or used a modified STEPS approach. From a bleak picture of very little data available in 2000 from most low and middle income countries, 10 years on we can see from the mapping of STEPS activities that many countries now have good data on NCD risk factors which they are using to guide their policy and programming in NCD. Countries increasingly report that having their own reliable data on risk factors leads to an increasing awareness and commitment to address NCDs, and is of utmost importance for setting meaningful NCD programme evaluation mechanisms at the national level.

The African region serves as an example, where risk factor surveillance has served as an entry point to programming for NCDs. Countries have started with an initial survey and followed this with the development of a national policy and programme formulation process involving key stakeholders to set clear and achievable targets for action based on their STEPS data. STEPS "Data to Action" workshops which have been piloted in three African countries - Benin, Mauritania and Cape Verde - have helped to accelerate this process by deliberately focusing on how the STEPS data can help a country consider what its priorities for NCD programming might be based on reliable, recent data.

Significant progress has been achieved in many other WHO regions as well. National policies on NCDs as well as programmes for reducing NCD risk factors such as unhealthy diet and physical inactivity are largely the result of having STEPS data.

Almost a decade of STEPS implementation has also proved that the evolving STEPS methodology is flexible and adaptable enough to be used even in the most resource constrained settings.
Challenges and limitations

Despite this progress, a number of limitations, challenges and constraints hamper broader progress in advancing NCD risk factor surveillance. Since NCD issues are often not prioritized at country level, NCD risk factor surveillance is also not considered a priority in many countries. There is inadequate progress in internalizing NCD risk factor surveillance into national health information systems; and NCD risk factors are not among the WHO mandatory reportable health indicators or the national essential health data set, nor among indicators set for the Millennium Development Goals (MDGs).

At the country level, progress in institutionalizing ongoing NCD risk factor surveillance is hampered by a number of factors. These include: the often high turnover of personnel involved in surveillance; the lack of resources available at the country level to support surveillance activities; out-of-date sampling frames; non-accessibility of some areas in some countries; weak infrastructure (e.g.: travel and transport systems) which make household surveys difficult; weak country capacity in data management, analysis and report writing; competing single issue surveys; and technological problems with Step 3 measurements, to name but a few. In a number of countries, these limitations have resulted in poor data quality.

Frequently the awareness generated by conducting a STEPS survey in a country leads to an increase in demand for preventive and curative health services – this demand is often unmet by the current health system in low and middle income countries.

Other challenges include the dependence on WHO for technical support and assistance, where WHO has few resources and personnel to help meet this demand. This is exacerbated by the absence of any international institutional infrastructure to provide coordinated support in NCD surveillance in general.

Multiple surveys at national and global levels are also being increasingly implemented, addressing some of the risk factors already captured in STEPS. Single issue surveys supported by WHO, including those on alcohol, nutrition, tobacco and injuries, tend to
elicit the same information, leading to survey fatigue in many countries. Since STEPS can be considered the primary data source of all major chronic disease risk factors, other surveys should consider the availability of STEPS results before introducing the same items or indicators.

**Future directions**

The need for robust, comparable NCD risk factor data at the national, regional and global level has been further strengthened by the Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases adopted by the World Health Assembly in May 2008. The Action Plan calls on WHO Member States to "establish a high-quality surveillance and monitoring system that should provide, as minimum standards, reliable population-based mortality statistics and standardized data on noncommunicable disease, key risk factors and behavioural patterns, based on the WHO STEPwise approach to risk factor surveillance." (World Health Organization, 2008). STEPS therefore remains a key approach and resource to help countries meet this obligation.

There remains a strong need to continue with the capacity building aspects of STEPS technical support to help build sustainable national capacity for NCD risk factor surveillance and institutional support for NCD surveillance. Increased advocacy efforts are needed at country level to improve linkages with NCD related data into national health information systems to ensure these have an integral place.

The STEPS methodology recommends the implementation of STEPS surveys 3-5 years and even this cycle is proving challenging in low resources countries. Support is needed to encourage countries to move from having conducted a baseline survey to having a regular and continuous cycle of risk factor surveillance reflected in their national NCD plans of action. Similarly, other countries need encouragement to move from sub-national, piecemeal implementation of STEPS surveys to capture national prevalence data where this would be preferable.
The questionnaire items and measures used in STEPS and the indicators reported from STEPS surveys need to be periodically reviewed to adapt to latest scientific standards and policy needs in countries. Recent discussions have focussed on whether items like urinary sodium content could be routinely captured in population based risk factor surveys such as STEPS. Similarly, measures like HbA1c as an indicator for diabetes could be included if and when more reliable, cost effective and portable measuring equipment is developed.

Efforts are needed to make the data collected from STEPS more widely available, so that it is fully utilized for strengthening NCD programming and policy making. Aggregate data is routinely entered into the WHO InfoBase (WHO InfoBase Home Page), but this relies on countries providing their published reports to WHO for this purpose. In 2007 WHO initiated the development of a Regional STEPS database for Africa, with countries agreeing to provide their unit record data from STEPS to allow for regional comparisons and analysis. The African data presented earlier in this paper is a direct result of this development. Extending this approach to other regions is necessary to ensure that all the STEPS data are made available and can be accessed through a central portal. Participation in such a mechanism should be agreed at that start of a survey.

Finally, future efforts to strengthen the linkages from data to action on NCDs at the country level remain a firm priority. One method which has shown promise in this area is the implementation of pilot workshops in selected African countries to strengthen the link between having the STEPS data and moving to action. There is enormous value in linking good national NCD risk factor data to processes which inform policy and programme making at the country level and help with target setting and monitoring of progress. This is after all one of the key goals of STEPS surveillance- to strengthen the availability of data to help countries inform, monitor and evaluate their policies and programs- and future STEPS work should remain firmly focussed on this goal.
REFERENCES


