The Contribution of Demographic Surveillance Systems: An INDEPTH Bibliometric Analysis of DSS Publications from Developing Countries

Amanda Brosius,[1] Don de Savigny[1], James F. Phillips,[2] Osman Sankoh,[3] and Fred N. Binka[3]

Abstract: *Using bibliometric techniques, we assembled a database of over 1,100 peer-reviewed publications reporting findings dependent on longitudinal or nested studies conducted in 45 demographic surveillance sites (DSS) since 1962. This database will provide an opportunity to analyze the contribution of DSS efforts to the advancement of public health knowledge, policy, and practice in developing countries. The first step in this analysis is to evaluate the relevance of DSS research fronts to prevailing public health priorities. We map the distribution of DSS publications with regard to demographic patterns, burden of disease, risk factors and health determinants, intervention trials, health system effectiveness, and Millennium Development Goals (MDGs). Results indicate a good concordance between publication focus and population health needs and a DSS research agenda since 1990 that is highly Millennium Development Goal relevant. Future work will be devoted to evaluating the influence of DSS research on health policy and practice.*

Introduction

Collecting information on population dynamics in a defined geographic area is as old as demography itself. Parish records and civil registers provided information for the earliest attempts to characterize mortality and population dynamics.[1] In the 20th Century, the role of population observatories expanded from description to investigation.[2] Research stations were created where vital registration in defined geographic areas was applied to assessing the demographic impact of an expanding range of epidemiological, policy, and demographic studies. By the 1960s, health and population research role of population laboratories was recognized as a scientific specialization within the field of demography. The term "demographic surveillance system" (DSS) emerged to connote the technologies associated with the continuous monitoring of births, deaths, and migration in a defined population over time.

Approximately forty DSS health and population research centers are currently in operation around the world. While some systems have been established for the purpose of descriptive demography, contemporary applications are usually established to evaluate the impact of health interventions.[3] However, well established demographic surveillance systems can provide concomitant support for multiple social, demographic, and economic investigations while pharmaceutical trials are also in operation.

[1] Swiss Tropical Institute, Basel, Switzerland.

[2] Population Council, New York.

[3] INDEPTH Network, Accra, Ghana.

The early era of population registration occurred in settings that were closed to migration. Surveillance systems in modern populations, however are distinguished by their methods for dealing with migration, whether defined in terms of an individual arrival or departure from a surveillance observation unit, such as the extended family, nuclear household or dwelling unit or through aggregate population observation that employs repeat censuses to impute populations at risk of these events over time.[4] While surveillance prior to the 1990s involved the repeat census approach, most demographic surveillance systems that have been established in the past decade have utilized continuous individual registration designs. This can be explained in part by the advent of low cost computer technologies that address many of the limitations of the individual surveillance approach and by the emergence of health technologies that require individual level trials.[5] Individual observation expands the range of social, demographic, and health research than can be conducted in conjunction with surveillance.[7]

The longitudinal evidence provided by demographic surveillance systems provides a unique opportunity to study long-term trends in population dynamics and health. We set out to evaluate the impact that demographic surveillance systems have had on health policy and practice by first establishing a searchable database of all DSS-based peer-reviewed publications, and subsequently conducting a preliminary analysis of database content, trends, and relevance to population health needs in developing countries. This paper reports findings from this bibliometric analysis of peer-reviewed demographic surveillance-based research from 45 demongraphic surveillance sites over the period from 1962 to the present.

Methods

Compiling the Database of DSS publications. Criteria used to determine inclusion of a paper in the database were included i) publications in English or French peer-reviewed journals and ii) papers that were based on data that were entirely dependent upon a demographic surveillance system. A list of publications was compiled for each site by conducting PubMed and ISI Web of Science searches using a combination of DSS site name, country name, and key author names. With the input and consent of the DSS site leaders a total of 1129 publications satisfying our criteria were entered into a Reference Manager database.

Preliminary analysis of database content, trends, and relevance. In order to facilitate reliable and standardized analysis of the database contents, we developed a list of terms customized for DSS relevance and assigned between two and six of these terms to each reference in the database. Using these keyterms, we are able to systematically probe the references in our database.

Results

The INDEPTH "publication galaxy." Before analyzing the database contents with regards to specific concepts, we aimed to gain a general appreciation for the distribution of the DSS papers across major themes and research fronts. Using a bibliometric mapping software, we identified key areas of DSS research. A closer examination of these fronts led us to plot them in detail on a set of axes, establishing a continuum from small scale/short term work through large scale/longitudinal work on one axis, and a progression from methods development to programmatic applications on another axis (Figure 1).

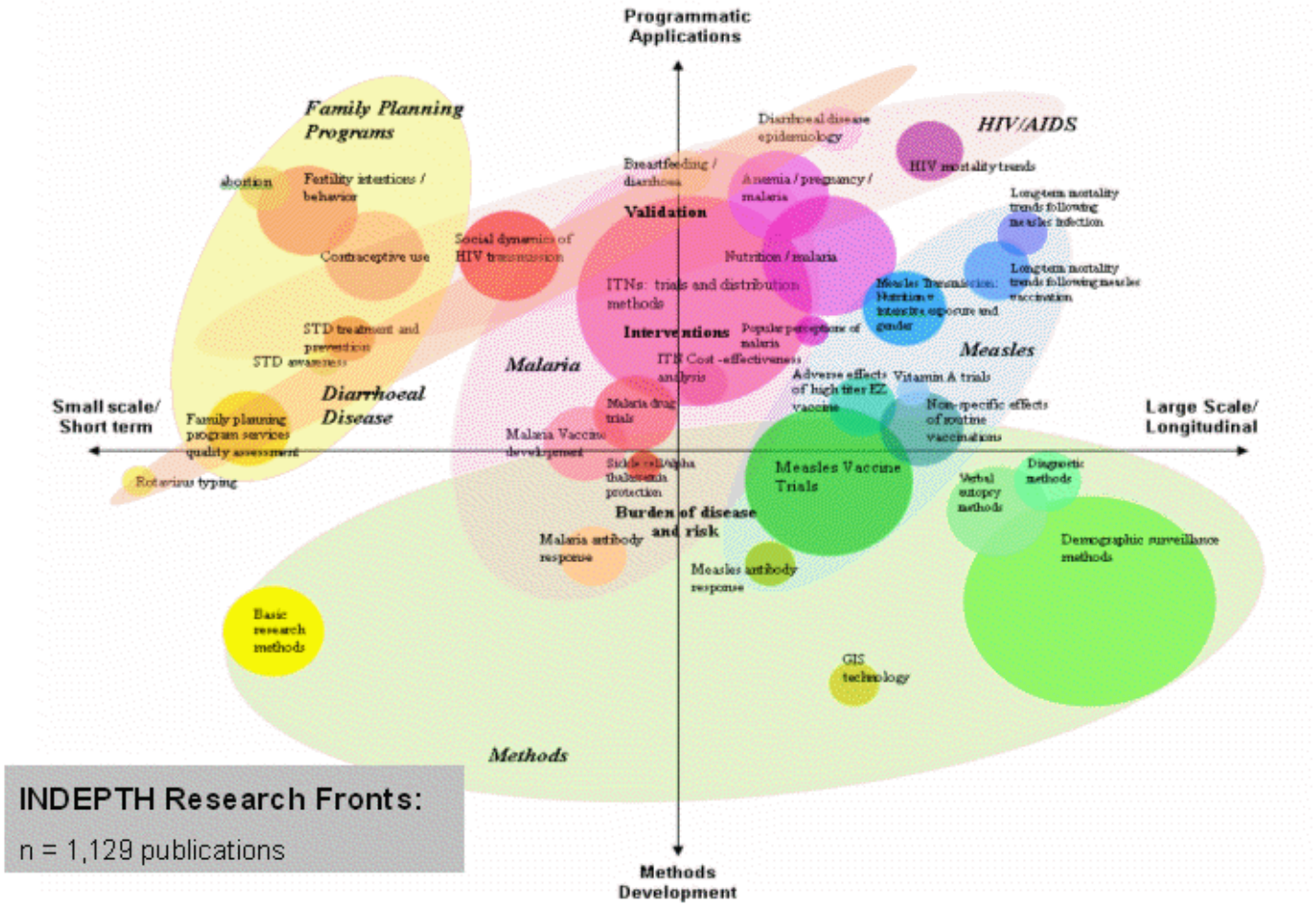

Figure 1. DSS Research Fronts

Disease-specific analysis: We examined the distribution of disease-specific DSS publications across the three groups of broad causes of Global Burden of Disease. Out of 834 disease-specific publications, 88% reported on group one causes (communicable diseases, maternal conditions, nutritional deficiencies, and perinatal conditions), 7% reported on group two causes (non-communicable diseases), and 4% reported on group three causes (injuries). Further analysis of group one and two causes allowed us to determine the proportion of papers dedicated specifically to communicable diseases, maternal

conditions, nutritional deficiencies, and perinatal conditions, and diabetes, respiratory diseases, cardiovascular diseases, and neuropsychiatric conditions, respectively. The breakdown of publications reporting on group one causes suggests that although perinatal mortality is a very addressable issue on DSS sites, it has not yet become a major focus of DSS publications.

To evaluate how well this allocation of publication focus compares with actual burden of disease, we separated African and Asian disease-specific DSS publications and examined their distribution across the three groups of broad causes of burden of disease in comparison with the 2002 burden of disease broad causes for the AFRO and SEARO regions as reported by the WHO. The African analysis demonstrates good correspondence between publication focus and actual disease burden, with slight under-representation of non-communicable diseases (NCDs) and injuries among DSS publications (Figure 2). The same analysis performed for Asian DSS papers, however, indicates a much more visible discrepancy between the proportion of Asian DSS publications devoted to NCDs and the proportion of disease burden attributable to group two causes, indicating the need for an analytic shift towards NCDs on Asian DSS sites.

A more detailed analysis of African disease-specific DSS publications in comparison with WHO reported disease-specific Disability Adjusted Life Years (DALYs) for the AFRO region reveals that four of the top five sources of DALYs are also among the top five most published disease topics, namely HIV/AIDS, Malaria, Diarrhoeal Disease, and Childhood Cluster Diseases. A critique of this data suggests an under- representation of publications on Lower Respiratory Infection among African DSS publications, given the actual burden of pneumonia in the AFRO region.

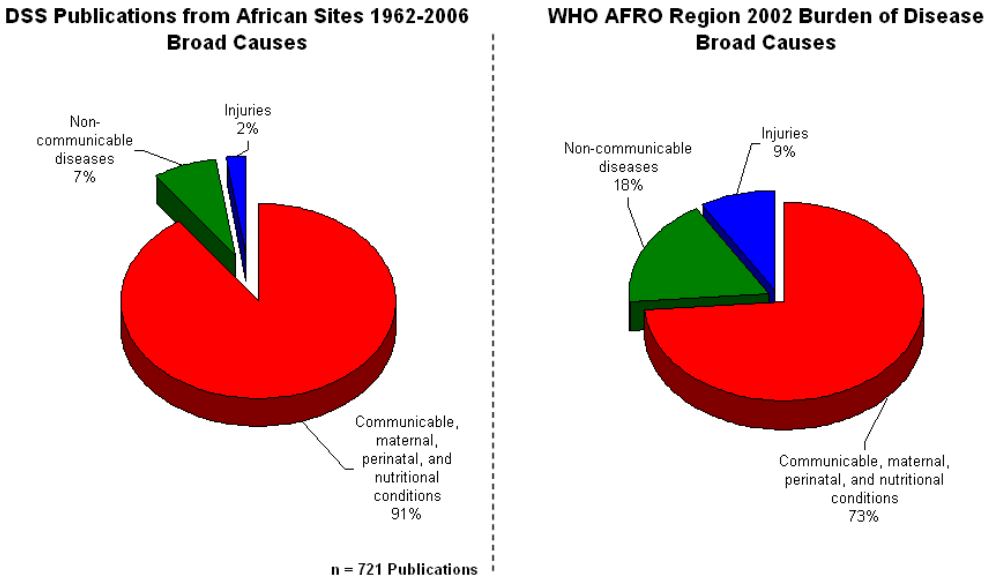

Figure 2. African disease-specific DSS publication focus cf. WHO 2002 reported Global Burden of Disease broad causes for the AFRO region.

Risk Factor Analysis: Examining the distribution of all DSS publications with regards to risk factors revealed that nine of the top ten most represented risk factors within the literature database are also among the top ten risk factors according to corresponding burden of disease in high mortality countries as reported by the WHO in 2000 (Figure 3). This analysis indicates that DSS research is well targeted to the key risk factors responsible for disease burden in these regions.

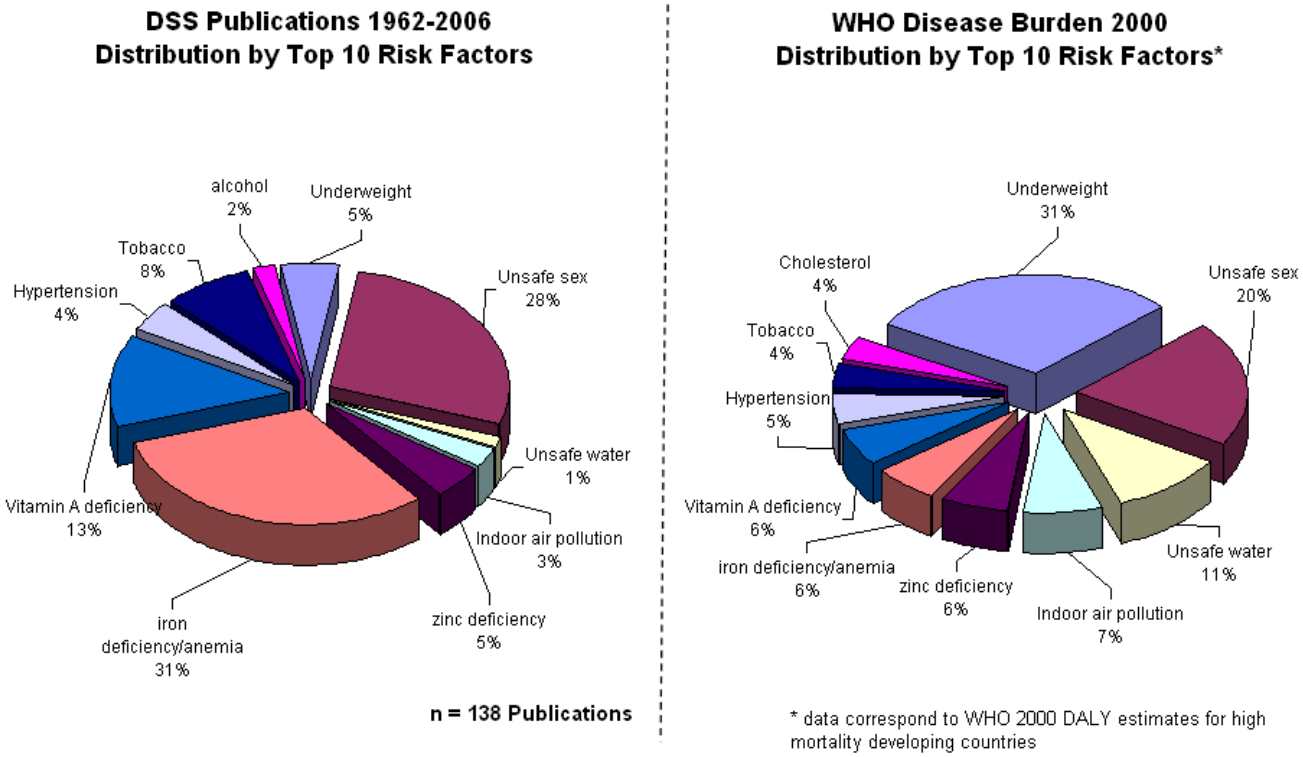

Figure 3. Top 10 risk factors represented among DSS publications cf. top ten risk factors according to attributable disease burden as reported for high mortality countries by the WHO in 2000

Examining the distribution of African mortality-specific DSS publications by age group (child/under-five, 5-14, 15-59, and 60+) in comparison with burden of mortality for the corresponding age groups as reported by the WHO in 2002 for the AFRO region indicates that DSS publications provide excellent coverage of child/under-five mortality. However, this publication focus may be occurring at the expense of DSS research on adult mortality on African DSS sites.

Methodological Analysis. An additional analysis performed looked at the distribution of DSS publications reporting specifically on the methodology of DSS research. Not surprisingly, the methods most reported on in DSS publications are those that make up the essential toolbox of the demographic surveillance system (DSS site logistics, verbal autopsy methods, development of health assessment and diagnostic tools, and vital events measurement). Papers reporting on those tools necessary to implement

the findings of DSS research and to interface these results with health systems and policy making, however, were only weakly represented among these publications.

Intervention Analysis. Examining the distribution of intervention-focused publications indicates that 30% of the 1129 publications report on health-related interventions. Half of these intervention publications are classified as intervention trial papers, while half are non-trial related. Finally, of the publications dedicated to intervention trials, 24% report on effectiveness trails, while 76% report on efficacy trials. Given the size of populations under surveillance on DSS sites, it is somewhat surprising that effectiveness trials are underrepresented among intervention trial publications.

MDG Analysis. To conclude our last analysis, we mapped DSS publications across the health specific Millennium Development Goals 4, Child Mortality, 5, Maternal Health and 6, HIV/AIDS, Malaria, Tuberculosis (Figure 4). We identified 524 MDG-relevant publications, representing nearly 50% of the entire database and indicating that the DSS research agenda is highly MDG-relevant. Although publication focus on tuberculosis appears to be weak in comparison with the attention given to other aspects of MDG 6 (HIV/AIDS, TB, and Malaria), and MDGs 4 (Child Mortality) and 5 (Maternal Health), our disease-specific analysis confirms that the proportion of publications addressing tuberculosis corresponds very well to the proportion of disease burden attributable to tuberculosis.

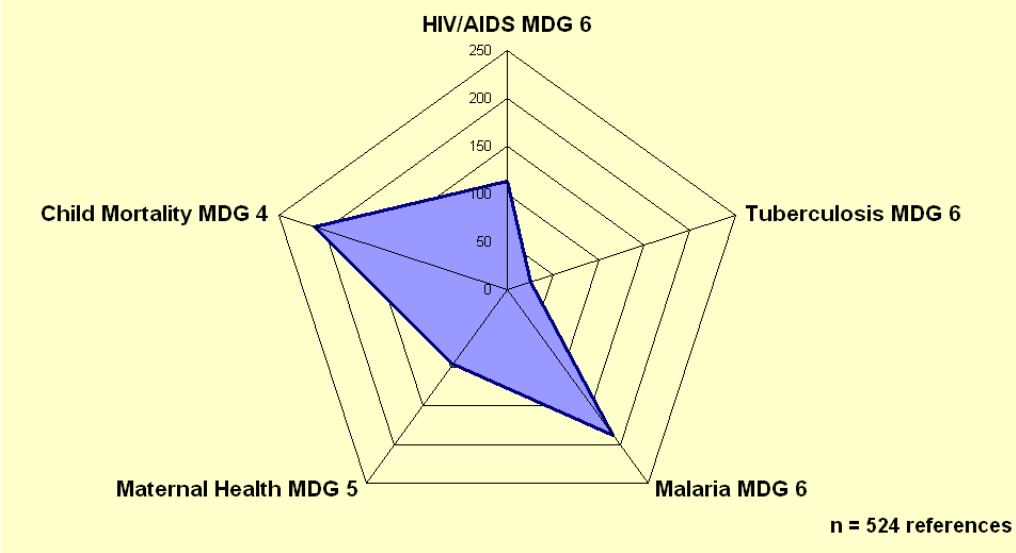

Figure 4. Distribution of DSS publications across MDGs 4, 5, and 6

Conclusion

The analysis presented here provides convincing evidence of the relevance of DSS research to population health needs in Asian and African developing countries. In summary, results indicate fairly good concordance between publication focus and population health needs with regards to burden of disease and risk factors and a DSS research agenda that is highly relevant to attaining Millennium Development Goals. A shift in publication focus towards adult mortality and non-communicable diseases in accordance

with the health transition occurring in these countries will allow DSS research to more accurately reflect disease burden in these regions in the future. Methodological analysis of the DSS publications demonstrates a strong tradition in efficacy trials with need for increased emphasis on developing tools to implement DSS research results and to bridge them with health systems and policy making. This bibliometric analysis is only a first step towards a broader goal of evaluating the impact of DSS research beyond the bounds of DSS sites. Continued work will address the downstream implementation of DSS research and evaluate the influence of DSS findings on improving health systems and revising health policy.

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[1] The earliest known calculations of mortality rates were based on civil registers for a segment of London that corresponds to contemporary definitions of a defined population (Graunt 1662). Fertility models have been based on archival 16th and 17th Century French parish registers that are similar to contemporary surveillance systems (Henry 1953). The first model life tables were based on population register mortality regimes from parish records (Coale and Demeny 1966).

[2] Early studies focused on epidemiological questions (e.g. Goldberger, et al., 1920). Following the Second World War surveillance systems were used for the demographic evaluation of health experiments. (See, for example, Ferebee, and Mount 1962)

[3] An international organization has been formed that disseminates DSS information from these sites (INDEPTH Network, 2002).

[4] Studies conducted by the British Medical Research Council in the Gambia and in East and Southern Africa have used this approach (Greenwood, et al. 1990). Dual registration systems were used to adjust coverage errors in population laboratories (Linder, F.E. 1971).

[5] For example, MacLeod et al. 1996.

[6] In the individual continuous observation approach, any cross-sectional study that records demographic surveillance identification numbers eventually becomes a longitudinal study of demographic processes. A few well designed surveillance sites have produced several thousand scientific publications (See, for example, Behar, et al., 1968; Scrimshaw, et al., 1968; D'Sousa, 1984; Menken and Phillips, 1990).