RESEARCH ARTICLE

Profile: Maternal and Child Health Surveillance System in peri-urban areas of Karachi, Pakistan [version 2; peer review: 1 approved with reservations, 2 not approved]

Previous title: Health and Demographic Surveillance System in peri-urban areas of Karachi, Pakistan


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Abstract

A Maternal and Child Health Surveillance System (MCHSS) was set up by the department of pediatrics and child health, Aga Khan University, Pakistan in peri-urban areas of Karachi to provide a platform for various research projects. It was established in five low-socioeconomic communities in a stepwise manner between 2003 and 2014. The total area currently under surveillance is 18.6 km² covering a population of 302,944. We maintain a record of all births, deaths, pregnancies, and migration events by two monthly household visits. Verbal autopsies for stillbirths, deaths of children under the age of five years and adult female deaths are also conducted. For over a decade, the MCHSS has been a platform for a variety of studies describing the burden of various infectious diseases like typhoid, pneumonia and diarrhea, evaluation of effectiveness of various treatment regimens for neonatal sepsis, assessment of the acceptance of hospitalized care, determination of the etiology of moderate to severe diarrhea, assessment of burden and etiology of neonatal sepsis and a multi-center cohort study measuring the burden of stillbirths, neonatal and maternal deaths. More recently we have also established a bio-repository of the well-characterized maternal and newborn cohort. Through a well-established MCHSS, we aim to provide concrete evidence base to guide policy makers to make informed decisions at local, national, and international levels.

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Approval Status

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2
3

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Any reports and responses or comments on the article can be found at the end of the article.
Keywords
Karachi, Heath and Demographic Surveillance System, HDSS, maternal and child health, longitudinal studies.

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First published: 04 Jan 2018, 2:2 https://doi.org/10.12688/gatesopenres.12788.1
Amendments from Version 1
We have updated version 2 according to the feedback by the reviewers. The article now describes the profile of a Maternal and Child Health Surveillance System (MCHSS) in peri-urban areas of Karachi, Pakistan. We have mentioned the commencement date of the surveillance system, response rates, migration details and various trends seen among the women and children in the MCHSS. We have also provided additional details with regards to key points such as the data collection process, database management and the structure of the MCHSS for better clarity. The article has been proofread to remove grammatical and typographical errors. The list of authors has also been updated.

Any further responses from the reviewers can be found at the end of the article.

Key messages
• The Karachi Maternal and Child Health Surveillance System (KMCCHSS) is a large demographic health surveillance system with a population of 302,944 in low socioeconomic peri-urban settings in Pakistan.
• It was designed as a platform to conduct epidemiological studies and provide a comprehensive sampling frame for these studies.
• The current focus is on etiological studies and controlled trials in the field of maternal and child health.
• All the studies aim for the improvement of public health policies and informed decision-making at local and national levels.

Why was the HDSS set up?
The world urban population is estimated to increase from 54% in 2014 to 66% (2.5 billion) by 2050 of which, about 90% is concentrated in developing countries. In Pakistan, Sindh is the most urbanized province where Karachi, a mega city, with the largest population is located. Urban dwellers mostly reside in settlements in peri-urban areas with the highest population density. These peri-urban areas experience a high maternal and childhood mortality. Additionally, Pakistan has a national database for registering vital events, such as births and deaths, but the coverage is sub-optimal with many births and deaths going unrecorded. Undercounting of these events leads to inaccurate estimates of vital health indicators. This inaccuracy hinders the setting up of priorities and allocation of scarce resources at the national level. Thus, the Karachi Maternal and Child Health Surveillance System (KMCCHSS) was established in its rudimentary form in 2003 by the department of pediatrics and child health of the Aga Khan University, Pakistan, in peri-urban areas of Karachi, with the mandate and aim to provide a research platform for both observational and interventional studies that could influence decision-making and planning for health strategies at local, national and international levels, as well as research training opportunities for students in maternal and child health. At the outset, various epidemiological studies were conducted in the area on infectious diseases of children, vaccine coverage and the impact of multiple interventions to fill the gap by providing essential information on the key indicators through regular data collection.

Some of the initial studies included identifying signs and symptoms in young infants requiring urgent referral and measuring the incidence of vaccine-preventable diseases such as rotavirus associated diarrhea, pneumonia, invasive pneumococcal disease (IPD), typhoid bacteremia and diseases such as omphalitis and their contribution in causing neonatal mortality.

What does it cover now?
The KMCCHSS is an efficient, cohesive, and dynamic surveillance system. It regularly collects information on vital and demographic events. Additional studies later included, studying etiology of moderate to severe diarrhea, the Global Enteric Multicenter Study (GEMS), comparison of effectiveness of different antibiotic regimens given as an outpatient therapy for management of sepsis in young infants, Simplified Antibiotic Therapy Trial (SATT) and a community-based etiology study of possible serious bacterial infections in young infants (0–59 days), Aetiology of Neonatal infection in South Asia (ANISA)\(^*\). Currently, ongoing studies include, exploring coverage of routine childhood immunizations and their impact on disease transmission e.g., impact of 10 valent pneumococcal vaccine on nasopharyngeal carriage, a randomized control trial for comparison of Amoxicillin and placebo in non-severe pneumonia in children 2 to 59 months old (RETAPP) and usefulness of thermal images in diagnosing pneumonia in children under five years of age. In order to understand the intergenerational effects of disease across the continuum of adult female, maternal and child health, relevant large cohort studies were added, Alliance for Maternal and Newborn Health Improvement study (AMANHI)\(^*\).
50,245 households are living. Each site has its own primary health care (PHC) center that has been established and operated by the Aga Khan University department of pediatrics and child health. These PHCs are accessible to populations within their catchment area and provide free care to children under five years of age.

Who is covered by the KMCHSS and how often have they been followed up?
The KMCHSS currently covers all the residents in the defined catchment areas with a particular focus on married women of reproductive age and their children under five years of age. In this system we define a ‘structure’ as a building with a single entrance and a boundary. These structures can be houses, hospitals, dispensaries, schools, shops, parks etc. Each structure has a nine-character unique number assigned to it which is written on the front door of each structure with black permanent paint to withstand the weather changes. A ‘household’ is a group of people living together under a roof (structure) and sharing the same cooking pot using the as per the International Network for Demographic Evaluation of Populations and Their Health (INDEPTH) definition of household. As the household is a basic unit, thus the number of households in each structure are determined, enumerated using an 11-character unique identification number. A ‘resident’ is defined as a person who stayed for at least six months or intends to stay for more than six months in the community.

The KMCHSS was established stepwise. It was initiated in 2003 in four peri-urban areas with focus on providing a platform to various studies. In 2010, the area was geo-mapped, and the first census was conducted. In 2014, it was extended to an additional area where the census was conducted in 2014. The most recent census was conducted in 2017. Until 2014, quarterly enumeration was done, and since then it has intensified to every two months, to be done by trained community health care workers (CHWs). They captured all new pregnancies, births, deaths and in and out migrations. CHWs are females with a secondary level of education and are mostly residents of the same communities where the surveillance is taking place.

We conducted a census by the end of 2017. The KMCHSS has a current population of 302,944 with 155,622 (51%) males and 147,322 (49%) females. Of the total population,
25% are females of reproductive age (between 15 to 49 years) and 14% are children under five years of age. The population age and sex structure are given in Figure 2.

What has been measured and how have the HDSS databases been constructed?
The baseline census and a follow-up census were conducted in 2010 and 2017 respectively. We recorded all the demographic data about vital events, migration patterns, socioeconomic status, knowledge, attitude and practices regarding micronutrients, reproductive history of selected pregnant/lactating women, knowledge, attitude and practices for family planning methods and unmet need of family planning, infant and young child feeding status, childhood morbidities, immunization status of children under 2 years, household food insecurity-food consumption and diet diversity, and hygiene practices and health care utilization of health centers. The tools for these modules were adopted from the UNICEF Multiple Indicator Cluster Survey\(^4^6\). The main demographic characteristics for the year 2017 are summarized in Table 1.

At each two monthly re-enumeration, CHWs move through the area using GIS-derived maps and collect/update the information on each household member. During the rounds, pregnant women are identified, registered, and followed. Their date of Last Menstrual Period (LMP) is recorded and in case any women is in doubt about her pregnancy, a pregnancy strip test is offered for screening. In the subsequent follow-up visits, counselling on birth preparedness is done and the date and time of birth, mode and place of delivery are recorded. In addition, the CHWs enquire about any birth event that has occurred in the household for all registered women, with a particular focus on women aged 15–49 years. Similarly, information on death including date, time, place, and the cause of death among all registered members are recorded. However verbal autopsies are conducted for deaths among children under 5 years of age and deaths among women of reproductive ages using the WHO Verbal Autopsy (VA) 2012 tools\(^1^7\)–\(^1^9\). VA for stillbirths were discontinued by the end of 2016. The cause of death assignment was done by trained physician using the ICD principles adapted from the revised WHO Verbal Autopsy Coding Standards\(^2^0\)–\(^2^2\).

**Database**
The data was entered and stored in a relational database with event-based programming developed using Microsoft Access 2010. A series of data quality checks were in-built to identify the inconsistencies and errors in data collection. It consisted of data entry screens, data edit and update screens, customized reports generation and data cleaning modules. A backup was also created. Routine error reports were generated during the round and at the end of surveillance round and discussed with

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**Figure 2.** Population age and sex structure in 2017.
in young infants. This algorithm was then incorporated into the Integrated Management of Childhood Illness (IMCI) and is in use to date21. A randomized control trial (RCT) compared procaine-penicillin and gentamicin, ceftriaxone and trimethoprim-sulfamethoxazole (TMP-SMX) regimens for the treatment of newborns, aged 0 to 59 days, with PSBI in an outpatient setting when hospitalization is declined. TMP-SMX showed the highest failure rate and case fatalities. Procaine penicillin-gentamicin turned out to be the most cost-effective route to treat these bacterial infections2. As a follow up to this trial, a randomized control open-label equivalence trial (SATT) in young infants with clinically diagnosed severe infections (CSI), seen at PHC, was done. The trial aimed to evaluate if (1) IM gentamicin once daily (OD) and oral amoxicillin twice daily (BD) for 7 days; and (2) IM penicillin and gentamicin OD for two days followed by oral amoxicillin BD for five days are equivalent to seven days of (3) IM procaine penicillin and gentamicin (reference therapy). The primary outcome of this trial was treatment failure (death, deterioration, or lack of improvement) within seven days of enrollment. Treatment failure rate were equivalent across three regimens. These findings were subsequently incorporated in the WHO guidelines for the management of young infants with CSI, and IM gentamicin OD and oral amoxicillin BD for 7 days was chosen as the treatment of choice2. A study, Global Enteric Multicenter Study (GEMS), exploring etiology of moderate to severe diarrhea (MSD), using quantitative molecular diagnostic methods showed Shigella spp, Rotavirus, Adenovirus 40/41, ST-ETEC, Cryptosporidium spp, and Campylobacter spp are responsible for 77.8% of all diarrheal causes. In another study, health seeking behavior for sick young infants was studied. The acceptance rate of hospitalized care was found to be 24%. Reasons for high refusal rate included financial difficulties, elders denying permission, and some based their decisions on religious and cultural beliefs. The acceptance of hospitalization was higher when the mother recognized the severity of the illness, presence of grunting, temperature <35.5°C and absence of language barrier at the local hospital. Gender was not a determining factor in decision making. This information forms learning points for interventions promoting health seeking behavior and formulation of alternative community based management plans for the betterment of child survival2. An RCT aimed to compare immunization coverage by administering pictorial messages promoting vaccines to mothers versus administering general health promotion messages to the control group. An improvement of 39% in the completion of DPT-3/Hepatitis B vaccines, which shows that simple health awareness interventions can go a long way in raising the health status of low-income communities4.

A randomized double blinded placebo-controlled equivalence trial was conducted in primary care settings, which aimed to determine optimal management of isolated fast breathing in young infants. The primary objective of the study was to evaluate if out-patient therapy of seven days of oral amoxicillin (reference therapy) is equivalent to the placebo. The primary outcome was to see the treatment failure by evaluation of hypoxia, organ failure, anaphylaxis, or hospitalization after

The site supervisor and coordinators by the data manager. All data queries were resolved before the end of a surveillance round. Clean data was encrypted and archived in a server at the Aga Khan University, Karachi Pakistan.

With the availability of newer technology, we had a transition from paper-based data collection to data collection on tablets/smartphones in 2017. Android mobile apps are developed for remote data collection. The data is stored in coded values in MySQL database hosted on a local machine inside Aga Khan University. All the data is synchronized and updated on the server daily.

Key findings and publications

The main demographic indicators across a period of six years have been represented in Table 2. There has been a decline in overall mortality rates. In the year 2017, these sites had a Crude birth rate (CBR) of 28.8, maternal mortality ratio (MMR) of 252 per 100,000 live births, neonatal mortality rate (NMR) of 42.6, Infant mortality rate (IMR) of 60.1 and under-five mortality (U5MR) of 69.5 per 1000 live births and stillbirth rate (SBR) of 32.4 per 1000 births. We recorded more in-migrations than out-migration at the surveillance sites (Table 2).

Figure 3 describes the trends in child mortality from 2012 to 2017. Under-5 mortality rates (U5MR) peaked in 2013 and 2016 due to the measles epidemic. Within the time period of six years, a reduction in neonatal mortality rates was observed. (Table 2 and Figure 3).

Several studies conducted in the KMCSSS have led the efforts to aid policy makers in making important decisions. One of these studies was the young infant clinical signs study (YICSS), which led to the formulation of WHO seven sign algorithm for detection of possible serious bacterial infection (PSBI)

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population, N</td>
<td>302944</td>
</tr>
<tr>
<td>Total Area</td>
<td>19</td>
</tr>
<tr>
<td>Total Structures</td>
<td>42565</td>
</tr>
<tr>
<td>Total Households</td>
<td>50245</td>
</tr>
<tr>
<td>Population Density / Sq Km</td>
<td>16317</td>
</tr>
<tr>
<td>Total Male, n (%)</td>
<td>155622(51%)</td>
</tr>
<tr>
<td>Total Female, n (%)</td>
<td>147322(49%)</td>
</tr>
<tr>
<td>Total population 15-49 years</td>
<td>76580(25%)</td>
</tr>
<tr>
<td>Children &lt; 5 year by, n (%)</td>
<td>41405(14%)</td>
</tr>
<tr>
<td>Annual pregnancies</td>
<td>9560</td>
</tr>
<tr>
<td>Annual live births</td>
<td>8731</td>
</tr>
</tbody>
</table>
Table 2. Health & Demographic Surveillance indicators and Trends by Year.

<table>
<thead>
<tr>
<th>Indicators (Rate/Ratios)</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude birth rate (CBR) per 1000 population</td>
<td>29.9</td>
<td>27.3</td>
<td>26</td>
<td>28.7</td>
<td>25.2</td>
<td>28.8</td>
</tr>
<tr>
<td>Maternal mortality ratio (MMR) / 100 000 Live births</td>
<td>426.9</td>
<td>361</td>
<td>427</td>
<td>373.6</td>
<td>336.2</td>
<td>252</td>
</tr>
<tr>
<td>Neonatal mortality rate (NMR) per 1000 live births</td>
<td>44.8</td>
<td>51</td>
<td>42.3</td>
<td>37</td>
<td>39.5</td>
<td>42.6</td>
</tr>
<tr>
<td>Infant mortality rate (IMR) per 1000 live births</td>
<td>66.7</td>
<td>77</td>
<td>65.8</td>
<td>58</td>
<td>62.5</td>
<td>60.1</td>
</tr>
<tr>
<td>Under-five mortality rate (USMR) per 1000 live births</td>
<td>78.5</td>
<td>89</td>
<td>77.2</td>
<td>70.9</td>
<td>76.7</td>
<td>69.5</td>
</tr>
<tr>
<td>Stillbirth rate (SBR) / 1000 Births</td>
<td>26.9</td>
<td>33</td>
<td>34.8</td>
<td>27</td>
<td>30.3</td>
<td>32.4</td>
</tr>
<tr>
<td>Abortion rate / 1000 among women aged 15-49 years</td>
<td>5</td>
<td>5.8</td>
<td>4</td>
<td>6.1</td>
<td>7</td>
<td>5.1</td>
</tr>
<tr>
<td>Pregnancy rate / 1000 among women aged 15-49 Years</td>
<td>186.6</td>
<td>163.2</td>
<td>157</td>
<td>183.4</td>
<td>185.6</td>
<td>122.9*</td>
</tr>
<tr>
<td>General fertility rate (GFR) / 1000 among women aged 15-49 Years</td>
<td>119.6</td>
<td>109.2</td>
<td>104</td>
<td>114.9</td>
<td>100.7</td>
<td>114</td>
</tr>
<tr>
<td>Child-woman ratio</td>
<td>707</td>
<td>683</td>
<td>629</td>
<td>608</td>
<td>548</td>
<td>541</td>
</tr>
<tr>
<td>In-migration / 1000 Midyear Population</td>
<td>54.3</td>
<td>44.2</td>
<td>33.7</td>
<td>21.1</td>
<td>25</td>
<td>3.6</td>
</tr>
<tr>
<td>Out-migration / 1000 Midyear Population</td>
<td>20</td>
<td>13.5</td>
<td>6.4</td>
<td>3.9</td>
<td>2.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Crude net migration rate</td>
<td>34.3</td>
<td>30.8</td>
<td>27.3</td>
<td>17.1</td>
<td>22.2</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Figure 3. Child Mortality Rates from 2012–2017, U5MR, under-five mortality rate; IMR, infant mortality rate; NMR, neonatal mortality rate.

Amoxicillin treatment regimen was found to be more effective than placebo with risk difference of 3.1, \( p=0.04 \) (95% CI 0.3, 5.8)\(^22\). A cohort study on calculating the neonatal mortality within 24 hours of birth was conducted in the rural areas of six countries, including the KHDSS in Pakistan. The neonatal mortality rates were higher than the published model-based estimates for these countries. Around one-third of the deaths occurred during first six hours after birth and a little under half of all neonatal deaths within 24 hours. The study concluded that implementing high quality obstetric and newborn care is a priority for preventing newborn deaths early on\(^23\).

A randomized control trial (RCT) was conducted to see the immunogenicity of poliovirus vaccines in chronically malnourished infants. Infants were randomized to receive one dose of either bivalent oral poliovirus vaccine (bOPV) alone or in combination with inactivated polio virus vaccine (IPV). The
results showed that those who were given bOPV+IPV together showed to close the immunity gap more than those who were given bOPV alone\(^1\).

A prospective cohort study in community-based research sites in south Asia and sub-Saharan Africa, between July 2012, and February 2016, we conducted population-based surveillance of women of reproductive age (15–49 years) to identify pregnancies, which were followed up to birth and 42 days post-partum. Verbal autopsies were done for deaths of all women of reproductive age, neonatal deaths, and stillbirths. Physicians used standardized methods for cause of death assignment\(^1\). This study revealed maternal mortality ratio (MMR) of 460 per 100000 live births, stillbirth rate (SBR) of 37.8 per 1000 births and neonatal mortality rate (NMR) of 50.1 per 1000 live birth. On VA analysis, among maternal deaths obstetric hemorrhage and hypertensive disorders in pregnancy contributed most to pregnancy related deaths, while neonatal deaths among perinatal asphyxia, sever neonatal infections and preterm birth complication and among stillbirths maternal infections, hypertensive disorders and antepartum hemorrhage were major causes of deaths\(^1\).

**Future analysis plans**

Future analysis plans include analysis of data from the multi-center Aetiology of Neonatal infection in South Asia (ANISA) study\(^2\). We are also conducting analysis to determine the burden of major maternal morbidities as part of the AMANHI study\(^3\). An additional analysis is on simplified methods to determine gestational age at birth by using a combination of physical and neurodevelopmental parameters. Also, as a part of AMANHI, we have established a biorepository of maternal, newborn, and paternal samples, collected at various time points during and after pregnancy. To the best of our knowledge, this is the only population-based biobank in Pakistan and one of the few in the region. Recently, we have secured funding from the Bill & Melinda Gates Foundation to follow the AMANHI bio-bank cohort for up to three years for neurodevelopmental milestones.

**Strengths and weaknesses**

In our demographic and surveillance system, all inhabited and uninhabited structures in the area have been mapped and surveyed. Each individual has been assigned a unique ID and surveyed every two months. The GIS coordinates of these structures, allow us to look at the spatial distribution of various maternal and newborn health indicators. Active surveillance of maternal and child health allows for the cohort to be a part of many multicenter studies, conducted with multiple international collaborators. Our long-term presence in the area has helped us establish good rapport with the population resulting in very low refusal rates.

Currently, the KMCHSS focuses on children under the age of five years and women of reproductive age, however the vital status and migration status of all household members are recorded. In the future, given adequate amount of funding we would like to expand our surveillance to cover these populations as well. With transition to electronic data collection and monitoring, we are aiming to integrate the surveillance system with our health center for electronic health records for better services to the community.

**Conclusions**

All the studies conducted at our surveillance sites aim for improvement of public health policies. The information we derive, aid us in making informed decisions at local, national, and international levels. These sites also play vital roles in training research personnel.

**Ethical statement**

Ethical approval for individual studies is obtained from Aga Khan University’s Ethical review committee. Written informed consent for publication of the participants’ details was obtained from the participants/parents/guardian/relative of the participant.

**Data availability**

The data collected by KMCHSS is not open source. De-identified data can be shared with other investigators upon request. Collaborative research projects are highly encouraged. Data sharing with other surveillance systems provides an opportunity to learn and understand geological differences. Data requests, enquiries and queries can be sent to Muhammad Imran Nisar (imran.nisar@aku.edu).

**Acknowledgements**


**References**


2. DHS. Demographic and health surveys. Calverton: Measure DHS. 2013. Reference Source

et al.


Open Peer Review

Current Peer Review Status: 💡 ✗ ✗

Version 1

Reviewer Report 26 February 2018

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James F. Phillips
Department of Population and Family Health, Columbia University, New York, NY, USA

This narrative alerts the reader to an important demographic monitoring activity in Karachi, Pakistan. Results that are reported are of considerable value, as no comparable data exist for an urban Pakistani population.

As a report on a demographic surveillance system, the paper is seriously deficient. Internationally known citations on DSS systems are not cited. The data capture procedure is unexplained, except with a sentence noting that the procedure is paper based. Far less expensive and less complicated procedures are available that are tablet based, with core software that is accessible without cost. The rationale for the utilization of obsolete and undoubtedly costly procedures is not explained. What is the software platform for this system? Was the software developed de novo? Or is this system adapted from applications that are functioning elsewhere?

Basic design features of the HDSS system are left unexplained. The most challenging problem confronting urban longitudinal research concerns urban mobility. How is migration monitored? If migration is not monitored, how is the population at risk of events determined? What is the visitation cycle? The reader assumes that the data are stored as a relational database, but most HDSS systems define data structure by social units. This article refers to buildings as if facilities are the organizing unit for data management. This would be an unconventional procedure that merits explanation.

Beyond alerting the reader to the existence of the system and its size and output, little in this article explains how the system is designed and what urban surveillance systems elsewhere could learn from this important example.

Is the work clearly and accurately presented and does it cite the current literature?
No

Is the study design appropriate and is the work technically sound?
No

**Are sufficient details of methods and analysis provided to allow replication by others?**

No

**If applicable, is the statistical analysis and its interpretation appropriate?**

Not applicable

**Are all the source data underlying the results available to ensure full reproducibility?**

No source data required

**Are the conclusions drawn adequately supported by the results?**

Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Demography

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 06 February 2018

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Peter Byass

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This is an interesting description of a surveillance operation on married women aged 15-49 and children under 5 years of age. However, such a limited surveillance operation cannot be described as a "Health and Demographic Surveillance System" - which should cover an entire defined population - and as such the title of the article is misleading. Furthermore, although this is described as a "Research Article", this is not the case - there is no research hypothesis, evaluation, or evidence-based conclusions. It is in fact a useful description of an on-going field operation, but that does not constitute a scientifically sound research article.

Some of the details are also questionable. The selection of only married women aged 15-49 will introduce severe bias in terms of some important outcomes like teenage pregnancy, abortion (natural or induced, legal or illegal). It is also not clear whether it is only the under-5 children of these married women who are included - which is another potential source of bias, since it is likely that children of unmarried women or mothers under 15 years of age would experience different
risks.

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**
No

**If applicable, is the statistical analysis and its interpretation appropriate?**
Not applicable

**Are all the source data underlying the results available to ensure full reproducibility?**
Partly

**Are the conclusions drawn adequately supported by the results?**
Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** population health; health and demographic surveillance systems

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 29 January 2018

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The manuscript by Ilyas and colleagues describes an interesting and important study site in four (nearly) contiguous communities in peri-urban Karachi, Pakistan. The authors also provided examples of various research projects attributed to the success of the surveillance system's
collection of data. The community of scholars working in cognate areas will be interested in, and
derive benefit from, learning about their work.

**Major comments**

However, and the “however” is significant, the research described in the manuscript does not
conform to a Health and Demographic Surveillance System (HDSS). It would be better described as
a Maternal and Child Health Surveillance System (MCHSS). Frankly, this is an important innovation
and should not be dismissed simply because it is not a HDSS. An HDSS follows whole of
population, whereas the Agha Khan site follows “only married women of child bearing age (15 to
49 years) and children under the age of five...” (p.4) The exclusion of **unmarried** women is
interesting, as is the under 5 cut-off.

It is noteworthy that, notwithstanding a rich and growing literature about HDSS, there is little

A further issue is the commencement date of the surveillance system. The **Introduction** (p.3)
places the commencement in 2003, but the census was only completed in 2010 (**Outputs of the
HDSS** p.4).

There is no statement about the response rate, whether it is constant, or declining, and
mechanisms for maintaining the cohorts participation.

**Additional comments**

**Abstract**
A good, brief description of the MCHSS's profile in Karachi was given by the authors - the nature of
MCHSS's establishment (year of set up, area of coverage, recorded data, purpose of the system)
was clearly stated – with the exception of the confusion around the commencement date. The
mentioned list of research projects following the utilisation of collected data highlights the
significance of the MCHSS as a research-facilitating platform in Karachi.

**Introduction**
Authors could consider signposting the flow of the manuscript in a clearer way, according to the
flow of the contents.

A good, general context of reasons for HDSS's set up was given, as well as the description of its
geographical positioning of sites within Karachi. However, statements ended vaguely, in terms of
the authors' elaboration of the respective communities. Moreover, there was a lack of information
detailing reasons of the system's set up in peri-urban areas and specifically in low income
communities.

The authors' explanation and description of surveillance structures could be structured better.

Inclusion and exclusion criteria of selected subjects were rather scattered throughout the article.
Mothers and infants appear in one place. The enumeration of men in another. This brings back
the previous point on better structuring of content. Terms on in/out migration were also lacking – did the surveillance system follow mothers and under 5’s or everyone?

Outputs of the HDSS and Discussion
The authors mentioned socioeconomic factors, without elaboration. What were the factors? This comes back to the earlier point made regarding the reasons of the HDSS’s set up in low income communities in areas of Karachi. What about higher income households in these peri-urban areas?

In addition, the authors could generate a summarized table of information used during surveillance.

It also seemed that the future research projects were given more focus in this article, as opposed to the key findings of the HDSS as is. While not strictly necessary for a profile paper, the results or trends found through the HDSS could be expanded further by explaining and discussing the relationship between documented socio-demographic data and collected health information of the respective communities in Karachi.

Data availability
While not a criticism of the Manuscript, rather an observation about the governance, it would be good if a more formalised description of data sharing could be referenced.

Grammatical notes
The article should be proof read and corrected prior to publication. There are a few noticeable grammatical and typographical errors.

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Partly

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Partly

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Epidemiology, demographic surveillance, population health measurement,
We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.