

Strengthening health systems through improved reliability of health information: An evaluation of the expanded programme on immunisation data management in Eastern Cape, South Africa

A-M Jamin,¹ MPH; B Kaposhi,^{1,2} MPH; D Schopflocher, PhD; N Mqoqi,² MSc

¹ University of Alberta, Valemount BC, Canada

² Eastern Cape Department of Health, Bhisho, Eastern Cape, South Africa

Background An initial review of District Health Information System (DHIS) data from Eastern Cape Province, South Africa, collected for the Expanded Programme on Immunisation (EPI), identified wide variations in reported rates of immunisation between sub-districts, with some consistently exceeding 100%. These impossible figures signal significant issues with data quality. To investigate these variations, and identify potential interventions, we designed a mixed-methods evaluation of the accuracy of reported immunisation coverage and challenges in data management.

Methods The evaluation was carried out in June and July 2012. Data audits and semi-structured interviews with key staff were conducted in 16 purposively selected health facilities and two sub-district offices from two of Eastern Cape's 24 sub-districts. Selected sub-districts were the ones reporting the lowest and highest coverage rates. The extent of the discrepancy between reported and verified data was calculated for each facilities. Multiple regression analysis identified factors related to these discrepancies. Content theme analysis of interviews was done to pinpoint recurring challenges in data quality assurance.

Results Reported immunisation coverage for the 24 sub-districts in Eastern Cape Province varied between 46.3% and 133.9%. Five of the sub-districts reported rates exceeding 100%. Results of audits in the two sub-districts reporting the lowest (SD1) and highest (SD2) figures showed that full immunisation was over-reported by 4% in SD1 and 85% in SD2. When stratified by facility, significant over and under-reporting existed in all facilities, although errors were far larger in SD2. Content analysis of interviews revealed that audit discrepancies related mainly to: availability and use of registers; poor verification processes; inadequate training; and communication issues. These challenges were present in both sub-districts although more frequent in SD2 where greater discrepancies were identified.

Conclusion Ensuring data accuracy is a significant problem in Eastern Cape Province. There are some clear steps the Provincial Department of Health can take to reduce errors. Recommendations include a) the central procurement of materials required for data management, b) the formation of Data Audit Teams to verify data, c) integration between Maternal, Child and Women's Health sub-programmes to improve communication, and d) the provision of training regarding data management processes.

Strengthen Health Sys 2014 epub ahead of print: DOI:10.7196/SHS.10

Strengthening health systems was enshrined as a global development priority in the 2005 Paris Declaration on Aid Effectiveness, which articulates signatories' commitment to "strengthening partner countries' national development strategies and associated

operational frameworks".⁽¹⁾ One result of this commitment is the increasing emphasis on evidence-based decision-making in policy and programme design over the past decade. Evidence-informed policy depends wholly on access to reliable information about health and

Corresponding author: **A-M Jamin** (ajamin@ualberta.ca)

activities of the health system. However, critical gaps in the collection and management of data persist in countries around the world, particularly developing nations.^[2,3] Incomplete, delayed, and inaccurate data are common features of health information collected and reported by health facilities,^[2] and this poor quality information continues to hinder evidence-informed policy and programme design improvements.

In South Africa, several challenges have been identified within the national data management system. A study conducted in KwaZulu-Natal Province indicated that health facilities in rural areas face significant challenges with: proper usage of data management tools; timely submission of data for aggregation; understanding of key indicators; validation of collected data; and data interpretation and use.^[4] Additional identified barriers were the minimal feedback given to facilities and the poor utilisation of information by management for decision-making.^[4] Recently, the national Government has made a concerted effort to strengthen data management systems across South Africa. One example of this commitment was the 2010 establishment of the Department of Performance Monitoring & Evaluation (DPME) in the Office of the President to coordinate measures of service delivery and to monitor the performance of various government sectors.^[5]

A functional monitoring and evaluation (M&E) system ensures that health information is collected and managed accurately so that it provides valuable information for the design, implementation, and improvement of health systems. Monitoring involves the routine measurement of progress towards programme objectives through measurement of selected indicators, focusing on the input, activity, and output components of programmes.^[6-8] Evaluation provides the separate, yet complementary, function of assessing a programme's merit through determining its relevance, effectiveness, sustainability, and efficiency.^[7] The United Nations Children's Fund (UNICEF) argues that it is primarily through the function of strong national M&E systems that the principles of the Paris Declaration can be realised.^[8]

Background to the study

In 2012, colleagues from the University of Alberta, Canada, and the Eastern Cape Department of Health (ECDOH), designed an evaluation of the Expanded Programme on Immunisation (EPI) data management to assess its accuracy and reliability. The School of Public Health at the University of Alberta provided

technical assistance in health surveillance, monitoring, and evaluation to the Eastern Cape Department of Health (ECDOH) between 2011 and 2013 through the secondment of a research associate and Masters in Public Health practicum activities. The evaluation formed part of this support.

Eastern Cape is one of South Africa's nine provinces, with a population of 6.7 million inhabitants.^[9] Primarily a rural province, Eastern Cape faces challenges with high levels of poverty, crime, inequality, and unemployment.^[9] The province's Human Development Index (HDI) figure, a composite measure of life expectancy, literacy, education, and standards of living, dropped from 0.582 in 1995 to 0.513 in 2010.^[10] Eastern Cape has one of the highest infant mortality rates (IMR) in South Africa: the provincial facility-based IMR increased from 28 deaths per thousand live births in 2005/06 to 32 per thousand live births in 2011/12.^[11]

South Africa has developed a national immunisation policy based on the World Health Organization's (WHO) Expanded Programme on Immunisation (EPI). Originally created by the WHO in 1974, EPI provides a set of guidelines that national governments can use to create appropriate vaccination schedules.^[12] Established by the National Department of Health (NDOH), the EPI-South Africa national policy adheres to these guidelines, providing routine vaccinations against eight major diseases: tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, haemophilus influenza type b, and measles. The NDOH incorporated rotavirus and pneumococcal vaccines, as well as a pentavalent vaccine against diphtheria, tetanus, pertussis, polio, and haemophilus influenza type b in a single dose, into a revised EPI schedule in 2009.^[13]

As vaccines are offered primarily to infants between birth and 9 months, the proportion of children who have received all their scheduled vaccines before the age of 1 year (fully immunised <1, FI<1) is a strong indicator of immunisation coverage. The ECDOH has reported a steady increase in immunisation coverage since 2002, as recorded in the District Health Information System (DHIS), an open-source health information software package designed in South Africa and rolled out nationwide between 1999 and 2001, which allows facilities to enter their own routine data so that it can be analysed at provincial and national levels.^[4,11] In 2011/12, 84.2% of children were reported as fully immunised in the province, against a national target of 90% coverage.^[11] When stratified by sub-district however, substantial variation existed, ranging from 46.3% to 133.9%.^[11] Reported immunisation coverage

in five of the 24 sub-districts exceeded 100%.^[11] These irregularities and unfeasible results suggested that there were substantial problems with data accuracy within the EPI programme. To address this, the M&E Directorate, in conjunction with the Maternal, Child and Women's Health (MCWH) Directorate, conducted an evaluation of the EPI programme's data systems to explore the accuracy of EPI data and barriers to the accurate management of data.

ECDOH uses the national DHIS to collect and analyse its data^[4] and applies the provisions of the 2011 District Health Management Information System (DHMIS) Policy as a framework to coordinate the management of health information from facility to national levels.^[14] The DHMIS policy includes the people, policies, procedures, datasets, hardware, and software that are essential to coordinate a functional information system and ensure that facilities use the information generated in decision-making. Under the DHMIS framework, health professionals record services in paper-based registers in real time as these services are provided. Health facilities aggregate register data on a monthly basis and transfer the information to Input Forms. The operational manager (OM) then verifies this information before submitting it to the sub-district information officer. At the sub-district level, the information is entered into the DHIS. Entering data into a software package assists with quality assurance: entered values must be between established minimum and maximum limits, missing records are flagged, and validation rules detect improbable relationships within data. Sub-district information officers and programme managers hold monthly meetings with health facility managers to review and discuss submitted data. After necessary revisions, monthly reports are submitted to district and provincial levels. Since the reported values for immunisation coverage in Eastern Cape were unfeasible for several sub-districts, we designed a study to examine the accuracy of recorded data, to quantify the magnitude of error, and to investigate which steps in the information management system were contributing to data inaccuracy.

Methods

The evaluation explored the accuracy of reported immunisation coverage and challenges hindering the management of EPI data in Eastern Cape. Data was collected in June and July of 2012 from Community Health Centres, Primary Health Care clinics, SD offices, and key stakeholders in two of Eastern Cape's 24 sub-districts. These sub-districts had large differences from

the provincial average immunisation coverage rates. SD 1 has consistently displayed the poorest performance in the province, reporting 46.3% coverage of children FI<1 in 2011/2012. Conversely, SD 2 has frequently reported coverage far exceeding 100%, and is responsible for reporting the highest proportion of children FI<1 in the province in 2011/12 at 133.9%.

Eight facilities and the sub-district office in each sub-district, comprising 38% and 35% of total facilities in SD1 and SD2 respectively, were visited. The chosen facilities had low, medium, and high coverage of children FI<1 relative to the total annual immunisation coverage of each sub-district. The primary questions explored by the evaluation were: Is EPI data managed accurately? If not, what are the challenges that hinder the accurate reporting of EPI data?

Procedures

The evaluation consisted of two primary activities: a) data audits to collect quantitative data, and b) semi-structured interviews to collect qualitative data. Site observations were also recorded by evaluators.

The principal investigator (PI) and M&E Directorate personnel, as well as the SD MCWH managers, data capturers, clinic supervisors, and staff present at each facility, participated in data audits. At each facility, groups of two to three evaluation team members manually counted the children recorded as FI<1 in each child health register. The number of FI<1 was totalled by page in every register and aggregated page totals were then separately counted by two team members. This process was completed for four months of the 2011/2012 fiscal year, one representative of each quarter. The OM of each facility provided copies of the Input forms for these four months, from which the reported number of children FI<1 was obtained. The verified and reported FI<1 numbers were recorded by the principal investigator. The evaluation team and clinic staff then discussed the quality and condition of the registers noting their observations.

Semi-structured interviews were conducted by the PI to determine the context of each facility and barriers to data management. The interview tool was based on the immunisation data quality audit (DQA) procedure created by the World Health Organization (WHO)^[15] and the Rapid Data Quality Assessment Tool (RDQA) co-developed by The Global Fund to Fight Aids, Tuberculosis and Malaria, Office of the Global AIDS Coordinator of the United States Government, the President's Emergency Plan for AIDS Relief, the United States Agency for International Development,

WHO, UNAIDS, and MEASURE Evaluation.⁽¹⁶⁾ The interview explored knowledge of immunisation indicators, compilation and verification of facility data, training processes, support and feedback from sub-districts, availability of data management tools, and general challenges. Interview responses were manually recorded by the principal investigator. To maintain a high standard of validity throughout the qualitative component of the evaluation Lincoln and Guba's⁽¹⁷⁾ concept of trustworthiness, and the criteria of credibility, transferability, dependability, and confirmability were

used. Credibility was sought by continually checking in with the evaluation team and participants throughout the processes of data collection and analysis for clarification and validation of identified themes. Transferability was sought by selecting low, medium, and high performing facilities in sub-districts which reported the lowest and the highest immunisation coverage in the province. Dependability and confirmability were sought by creating a comprehensive audit trail. The principal investigator maintained a journal detailing the assumptions, reactions, and reflections experienced throughout the data collection process to provide the concrete evidence required for an audit trail.

Table 1. Frequency table of reported immunisation coverage <1 year in Eastern Cape, South Africa, by sub-district (DHIS, 2012)

Immunisation coverage of children <1 year (%)	Frequency (sub-districts)
40-50	1
51-60	1
61-70	1
71-80	4
81-90	4
91-100	8
<100	5
Total:	24

Table 2. Reported and verified proportion of children fully immunised <1 year, by facility

Sub-district	Facility	Reported on DHIS (%)	Verified by EPI audit (%)
SD2	F1	16.6	1.4
	F2	358.7	1.4
	F3	88.7	39.4
	F4	67.9	73.2
	F5	105.4	187.9
	F6	75.1	0.8
	F7	0	0.8
	F8	429.1	137.4
	Mean SD2:	166.4	24.9
SD1	F9	108.6	48.9
	F10	36.2	24.5
	F11	26.3	26.7
	F12	52.5	36.4
	F13	32.5	35.7
	F14	57.4	51.5
	F15	0	15.2
	F16	28.7	12.3
	Mean SD1:	32.2	31

Findings

We visited 16 health facilities and two sub-district offices in the sub-districts identified as having the highest and lowest reported immunisation coverage rates, after initial review of all sub-districts DHIS data on immunisation coverage from 2011/12 (Table 1). This purposively selected sample included primary health care clinics and community health clinics. The facilities served populations with a range of 19-518 children younger than 1 year and were all in rural areas. The size of the facilities was related to their functions. All of the facilities offered ante and post-natal care (including for HIV positive mothers and babies), all had beds for delivery, and all offered routine immunisation services for babies without the need for referral to another facility. Two of the facilities were in areas that experience significant seasonal migration as a result of the agricultural industry, which affected their estimates of their catchment population. As expected, all facilities were found to maintain some form of a child health register, and to communicate collected data to the sub-district offices as per policy.

Audit findings compared reported immunisation coverage to the actual immunisation coverage rate derived from manual counting of the child health register in each facility. Table 2 shows the differences between reported and audited coverage rates for each of the 16 facilities visited.

Overall, the data audit revealed some extremely large discrepancies between reported and verified data, particularly in sub-district two (SD2). In some cases, the reported rates on DHIS seemed to bear no relation to the rates by manual count from facility records. For example, in facility 2, SD 2, the DHIS reported rate of immunisation coverage was 358.7% compared with the manually counted rate of 1.4%.

On average, the indicator FI<1 was over-reported on DHIS by 85% in SD2 (n=8) (reported FI<1 = 2539,

verified FI<1 = 380). In SD1, the indicator FI<1 was over-reported on DHIS by 4% (n=8) (reported FI<1 = 378, verified FI<1 = 363). In SD 1, the mean discrepancy between the verified and reported proportion of children FI<1 was low at the sub-district level; however, when the data were analysed by facility, both under-reporting and over-reporting errors were found. These errors were smaller than in SD 2 and had little influence on the mean sub-district coverage rate.

Statistical analysis

A sequence of multiple regression analyses¹⁸ was conducted using SPSS. The dependent variable was the difference between the FI<1 from the reported data and the audited data. The independent variables were successively entered in the following order: facility size, sub-district, the interaction between the facility size and the sub-district, and a set of dummy variables representing the month in which the data was initially reported. The variables representing month were not jointly significant ($F=0.098$; $df=3,57$; $p>0.5$), and were dropped from the final model. Because the interaction term between sub-district and size of facility was significant when added to the equation ($F=17.073$, $df=1,60$, $p<0.001$), the final reduced model contained sub-district, size of facility, and the interaction term. The R^2 for the final model was 0.415 ($F=6.736$; $df=6,57$; $p<0.001$). Figure 1 presents the final model.

In SD2, the larger the facility size, the greater the identified discrepancy between reported and verified data.

Interviews

Twenty-three interviews (18 health professionals, three sub-district managers, and two sub-district data capturers) were conducted to understand the context for the audit discrepancies. Content analysis of semi-structured interviews and facility site observations identified five recurring themes: a) unavailability of appropriate registers and b) insufficient verification processes, c) inadequacies in the general use of registers, d) training processes, and e) communication between MCWH programmes. These were present in both sub-districts, though to a greater degree in SD 2, and contributed to error in both over-reporting and under-reporting.

Appropriate registers. The majority of facilities in both sub-districts experienced prolonged periods in 2011/12 where they were not provided with any registers to record services. Further, when facilities were supplied with registers, these were often older versions that did not correspond to updated provincial reporting

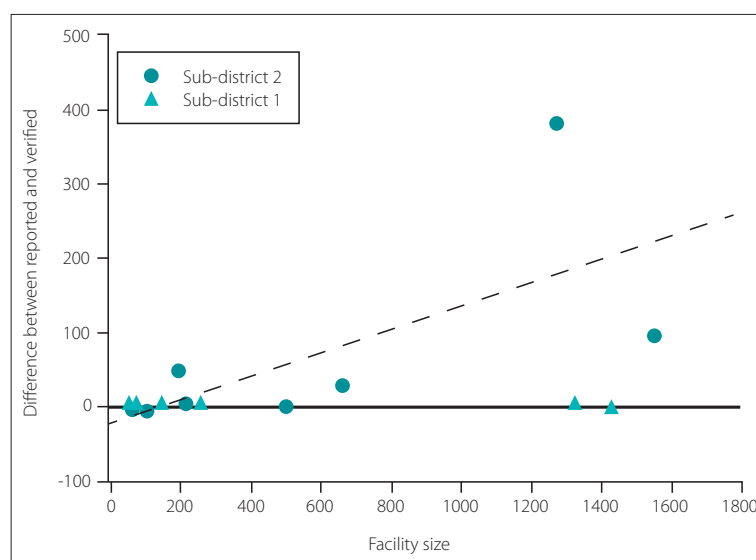


Figure 1. Differences between reported and audited counts of children fully immunised under 1 year, by facility size and district

requirements. Facilities demonstrated creativity in adjusting or creating their own source documents; however, these documents lacked standardisation and often did not include all essential data elements, particularly the data element "FI<1".

Verification processes. Before submission to the SD, EPI data is supposed to be verified by the OM to ensure that the quality of reported data is maintained. In many facilities, however, this verification process does not occur. Monthly verification meetings were held in each SD; however, these meetings assessed face validity of the Input forms only, without reference to the source documents (registers).

General use of registers. Consistently poor general usage practices of health registers were observed. Health professionals manually record the services provided, and tick appropriate columns for labeled data elements. Limited adherence to the tick system, unorganised recording methods, and failure to maintain running totals accounts for a substantial margin of error when compiling monthly statistics.

Training processes. As many facilities in the selected sub-districts are remote and lack essential resources, staff turnover remains high. There is no comprehensive orientation for new or contract nurses in data management. On occasion representatives from health facilities are selected to attend organised data management trainings. Retention, transfer, and use of knowledge related to EPI data management remain alarmingly low however; even two to four weeks after trainings take place.

Communication between MCWH programmes. In addition to the EPI programme, MCWH sub-district managers oversee nutrition, reproductive health, and antenatal care programmes that are managed separately at the provincial level. A lack of coordination between the provincial MCWH programme managers is a hindrance to the ability of SD MCWH managers to provide effective support to facilities and activities they are responsible for.

Recommendations

The following recommendations flow directly from the identified themes.

1. Procure registers centrally

Ensuring that facilities have a consistent supply of updated registers would promote standardisation and a consistent record of all required data elements. Centralised procurement of registers by the ECDOH may increase buying power and promote accountability of suppliers. Procurement must be aligned to any changes made to reporting requirements.

2. Verify facility data using source documents

Verification of source documents and Input Forms must occur at the facility and sub-district level. The periodic verification of data, through supervision and data auditing, has been identified as a necessary step in promoting accountability and accuracy of health information.^[6,7,19] Sub-districts should form Data Audit Teams consisting of sub-district programme and information managers, clinic supervisors, and data captureurs to provide supervision and support for facilities. An inter-sectoral team could verify the previous month's information, assess the quality of data management, and provide in-service support on any gaps identified as modelled by the M&E Directorate. In the recurring context of fiscal limitations, strategic partnerships with local non-governmental organisations might assist.

3. Provide training about data management processes

Comprehensive training should include proper register usage, definitions of data elements and key indicators, and basic interpretation of data. Facility staff would benefit not just from orientation concerning EPI data management, but a broader orientation on all programmes a facility is responsible for, in order to establish a foundation for best practises. Programme and information managers could accomplish this through in-service training or the creation of a user-friendly handbook including standardised data management processes for all programmes.

4. Increase integration between MCWH sub-programmes

The improvement of EPI data management also requires

significant communication and support at the provincial level. Increased integration between MCWH sub-programmes at the provincial level would limit the overlap of trainings and activities between the different programmes they are responsible for, allowing MCWH sub-district managers to coordinate their duties more effectively.

Discussion

Findings from this evaluation contribute to an existing body of evidence that describes the challenges in accurate and appropriate management of data in low-middle income countries. The capacity of nations to develop and operationalise appropriate health strategies is greatly strengthened by developing functioning M&E systems to provide the relevant information and evidence.^[3,8,20-22]

Neither donor nor national government funding has followed the voiced support for strengthening informed health systems. Between funding rounds four and seven for example, The Global Fund reduced allocation to M&E systems from 5% to 3%.^[21] A study^[23] on global health investments identified the median expenditure on M&E at the national level to be 1.8% – far from the recommended 5–10% of programme funds. Only 67% of 185 countries reported the implementation of a functional M&E unit.^[23] Of these countries, only one-third reported all key partners to have aligned their M&E requirements with the national M&E strategic plan.^[23] The gap between high level commitment and action has perpetuated inefficient and dysfunctional reporting systems and continues to undermine countries' efforts to make evidence-based decisions.

It is clear that action must be taken towards the global commitment to strengthen M&E systems. This need is apparent in the case described in this paper, where although the national government has identified M&E as a central component for strengthening its health system, there is very limited capacity to implement a functional M&E system countrywide. Financial constraints remain a substantial challenge particularly in the Eastern Cape Province where a negligible amount is allocated to the M&E Directorate.

Limitations

There are limitations to this evaluation. Due to economic and time constraints, only two sub-districts were evaluated. The facilities within these sub-districts were not randomly selected but were instead chosen because of their reported coverage rates. This study design limits the generalisability of the findings; however, enabled investigators to understand some of the specific constraints hindering data accuracy in the

chosen context. There were complexities in analysis of immunisation coverage rates because of uncertainties surrounding the catchment population for facilities in areas where seasonal migration influenced population numbers. This feature could explain some of the >100% coverage reports in some sub-districts. In addition, the cross-cultural nature of qualitative data collection, since not all the interviewers were from South Africa, may have increased the margin of error for data interpretation.

Conclusion

This evaluation of EPI data management in two ECDOH sub-districts revealed substantial error in reported EPI data and identified reasons for these discrepancies. Challenges with data management are not unique to the EPI programme or to the Eastern Cape province of South Africa, and the findings from this evaluation may point to potential interventions to increase the reliability of health information elsewhere. They support a demand for further research into the error rates of reported data across the province and nationwide, and action to ameliorate the conditions that facilitate these errors. Ensuring quality and reliability of data is a crucial step towards strengthening health systems and supporting evidence-based management and decision making to improve health outcomes.

References

1. OECD Development Assistance Committee. Paris declaration on aid effectiveness: Ownership, harmonisation, alignment, results and mutual accountability. OECD High Level Forum; 2005 February 28- March 2; Paris France, 2005. http://www.live.who.int/medicines/technical_briefing/tbs/parisdeclarationengl.pdf (accessed 24 September 2014).
2. World Health Organization & International Health Partnership. Monitoring, evaluation and review of national health strategies: A country-led platform for information and accountability. Geneva: World Health Organization, 2011. http://www.who.int/classifications/ME_component_nationalhealthplans_prepub_july2011.pdf (accessed 4 October 2012).
3. Chan M, Kazatchkine M, Lob-Levyt J, et al. Meeting the demand for results and accountability: A call for action on health data from eight global health agencies. *PLoS Med* 2010; 7(1): e1000223. DOI: 10.1371/journal.pmed.1000223.
4. Garrib A, Stoops N, McKenzie A, et al. An evaluation of the District Health Information System in rural South Africa. *South Afr Med J* 2008; 98: 549-522. <http://www.ajol.info/index.php/samj/article/viewFile/13926/59709> (accessed 14 May 2012).
5. Department of Performance Monitoring and Evaluation. About DPME and its mandate. Pretoria: the Presidency Republic of South Africa, 2013. <http://www.thepresidency-dpme.gov.za/pebble.asp?relid=36> (accessed 23 January 2013).
6. UNAIDS. Basic terminology and frameworks for monitoring and evaluation. Monitoring and evaluation fundamentals series. http://www.unaids.org/en/media/unaids/contentassets/documents/document/2010/7_1-Basic-Terminology-and-Frameworks-MEF.pdf (accessed 24 September 2012).
7. Gorgens M, Kusek J. Making monitoring and evaluation systems work: A capacity development toolkit. Washington, DC: World Bank Publications, 2009.
8. UNICEF. Bridging the gap: The role of monitoring and evaluation in evidence based policy making. New York: the Evaluation Working Papers, 2008. http://www.pol.ulaval.ca/perfeval/upload/publication_70.pdf#page=98 (accessed 24 September 2012).
9. Province of the Eastern Cape. The Eastern Cape socio economic review and outlook. Province of the Eastern Cape Economic Development and Environmental Affairs & Province of the Eastern Cape Provincial Treasury, 2011. <http://www.dedea.gov.za/Newsletters%20and%20Publications/EC%20Socio%20Economic%20Review%20and%20Outlook%202011.pdf> (accessed 25 September 2012).
10. Eastern Cape Socio Economic Consultative Council. Eastern Cape development indicators, 2012. http://www.ecsecc.org/files/library/documents/EasternCape_withDMs.pdf (accessed 14 March 2013).
11. Eastern Cape Department of Health. Sub-district raw data [Database]. 2012. Available from: District Health Information System; 2001
12. World Health Organization. Immunization systems and policy, 2012. http://www.who.int/immunization_delivery/systems_policy/en/ (accessed 14 March 2013).
13. Expanded Programme on Immunisation South Africa. In: Vaccinator's Manual "Immunisation that works", 4th ed. Pretoria: The National Department of Health, 2012. http://www.doh.gov.za/docs/services/2013/Vaccinators_Manual_09July_2013.pdf (accessed 15 May 2012).
14. National Department of Health. District Health Management Information System Policy. Pretoria: National Department of Health, 2011.
15. World Health Organization. The immunization data quality audit (DQA) procedure. Department of immunization, vaccines and biological, 2003. Available from: <http://www.who.int/vaccines-documents/DocsPDF03/www759.pdf> (accessed 16 April 2013).
16. The Global Fund to Fight AIDS, Tuberculosis and Malaria. Routine Data Quality Assessment (RDQA) Tool [spreadsheet]. Geneva: Global Fund to Fight AIDS, Malaria and Tuberculosis, 2008. <http://www.theglobalfund.org/en/me/documents/dataquality/> (accessed 20 September 2011).
17. Lincoln YS, Guba EG. Naturalistic inquiry. New York: Sage Publications Inc, 1985
18. Cohen J, Cohen P, West SG, & Aiken, LS. Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. 3rd ed. Mahwah, NJ: Lawrence Erlbaum Associates, 2013.
19. Nielsen SB, Ejler N. Improving performance? Exploring the complementarities between evaluation and performance management. *Evaluation* 2008; 14(2): 171-192. doi:10.1177/1356389007098538
20. Bosch-Capblanch X, Lavis J, Lewin S, et al. Guidance for evidence-informed policies about health systems: rationale for and challenges of guidance development. *PLoS Med* 2012; 9(3): e1001185. doi:10.1371/journal.pmed.1001185
21. Holzscheiter A, Walt G, Brugha R. Monitoring and evaluation in global HIV/AIDS control: Weighing incentives and disincentives for coordination among global and local actors. *J Int Dev* 2012; 24: 61-76. doi:10.1002/jid.1705
22. Price K. The evolution of understanding: positioning evaluation within a comprehensive performance management system. In S. Mathison (Ed.) Really new directions in evaluation: Young evaluator's perspectives, number 131. Hoboken: Wiley, 2011. <http://onlinelibrary.wiley.com/login.ezproxy.library.ualberta.ca/doi/10.1002/ev.386/abstract?sessionId=FBCA236BAFA0E75E2DA76A73FBF0DD8C.d01101> (accessed 28 September 2012).
23. Peersman G, Rugg D, Erkkola T, et al. Are the investments in national HIV and monitoring systems paying off? *J Acquir Immune Defic Syndr* 2009; 52: S87-S96. doi: 10.1097/QAI.0b013e3181baede7

