Using electronic syndromic surveillance system to collect animal health and meat inspection records in Marsabit County, Kenya

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Abstract

Introduction: An electronic syndromic surveillance system for collecting, collating and analysing animal health and meat inspection records in Marsabit County, Kenya has been developed.

Architecture: The system comprises a cloud server linked to a series of data collection phones operated by field veterinarians based at the sub-county locations and meat inspectors in abattoirs. Animal health data are collected by sub-county veterinarians during their routine active surveillance missions or via telephone contacts with community disease reporters (CDRs) who are based at the village; these CDRs have been trained on disease recognition and reporting. Each veterinarian is expected to make weekly phone calls to each CDR to check whether there has been any incident that needs to be reported during the intervening period. However, when there is an outbreak, the CDRs from affected village call the veterinarian to whom they report to provide the data. Sub-county veterinarians upload the syndromic reports to the online server at the end of each day. Abattoir data on the other hand are uploaded by the meat inspectors to the database directly at the end of each day. The server has scripts written in Java language for automated data management and analysis. Descriptive results produced include trend graphs, heat maps and word clouds on reported syndromes.

Initial observations: For livestock diseases and syndromes, the system currently indicates that a total of 130 reports have been made over the last six months. The number of reports by sub-county varies from 65 in Laisamis, 46 from Moyale, 14 from Saku and 5 from North Horr. The common syndromes captured in the word cloud include coughing, mucoid nasal discharge, severe breathing difficulties and thickening of the skin. The numbers of cattle slaughtered and inspected in the County abattoirs in the months of September, October and November 2017 were 178, 212 and 203 cattle, respectively. The combined numbers of sheep and goats slaughtered at the same period were 989, 1078 and 1011, respectively. Cases reported from post mortem inspections in the abattoirs included facioliasis, pneumonic lungs, abscesses and cysts.

Conclusion: The system improves the capacity of the department to collect and manage data that could have otherwise been keep in paper forms. The analyses conducted also show a good level of agreement between animal health data and post mortem findings. This is because the common animal health syndromes reported by CDRs were coughing and severe breathing problems, while a high proportion of post mortem cases observed were pneumonic lesions. This demonstrates the utility of using multiple sources of data for triangulation purposes.

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Introduction

Syndromic surveillance system encompasses methods that are used to detect individual or population health indicators for action before confirmatory diagnoses are made [1]. They support traditional surveillance through collation of data, generation of epidemic curves or risk maps, or strengthening the existing linkages between multiple actors involved in disease surveillance. They are founded on the premise that affected individuals or populations manifest key symptoms or clinical signs that are indicative of a given health problem. They were conceptualised to support early detection of emerging public health threats although their use has gradually been expanded to include the animal health sector. The scope of these systems has also been extended to include endemic public and animal health problems, abattoir surveillance (such as the work done by Muellner et al. [2]) and detection of diseases in wildlife. These additional functionalities can foster wider application of these systems. The critical step in the development of these systems is in the development of case definitions or syndrome categories from classical disease descriptions so that incident cases are carefully clustered and appropriately responded to.

Although it is expected that syndromic surveillance systems can enable faster detection and response to diseases compared to the standard surveillance systems, their application is beset by numerous challenges particularly in livestock farming areas in the sub-Saharan Africa. In these areas, communication networks such as those based on mobile phones have poor coverage. Moreover, access to animal health services is inadequate; poor response to disease outbreaks therefore erodes incentives for reporting among the livestock owners. The efficiency of syndromic surveillance systems is also dependent on the accuracy of case detection being used, strong linkages with the target communities and presence of well-defined response protocols. Other factors that influence their effectiveness include the size of an outbreak, degree of dispersion of the population affected and presence of clear criteria for determining thresholds for alerts [3].

Questions abound on the usefulness of syndromic surveillance systems especially when there is no key event to look for. For instance, it is not clear whether these systems would produce new and potentially useful information about naturally occurring infectious diseases or strengthen public and animal health service delivery systems when the key limiting factor is lack of access to resources [4]. These questions are relevant in most pastoral production systems in Kenya where better approaches to disease prevention and control are required to improve the livelihoods of the local people.

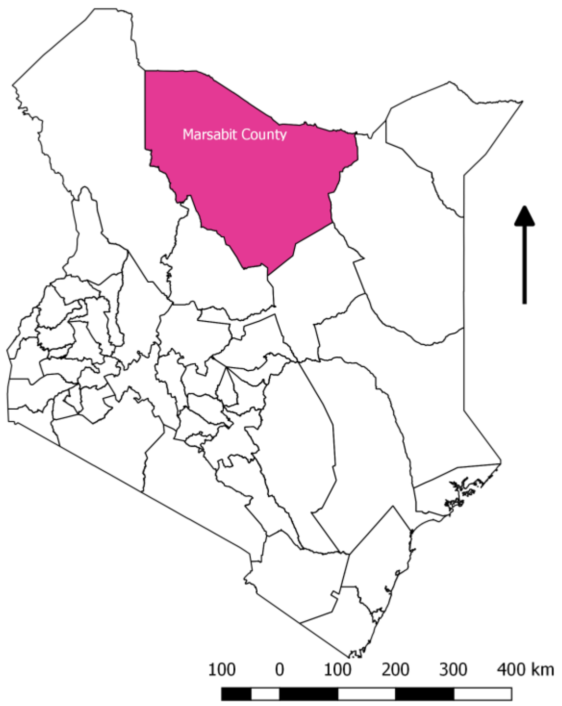
We implemented an electronic surveillance system in Marsabit County, northern Kenya, under the Feed the Future Accelerated Value Chain Development – Livestock Complement project, to evaluate its feasibility for routine use in animal health and abattoir surveillance. Many livestock diseases are endemic in the area, such as contagious bovine pleuropneumonia, contagious caprine pleuropneumonia, peste des petits ruminants, brucellosis and foot-and-mouth disease. A component of the work involved slaughterhouse surveillance.

Methods and system architecture

Area

The activity was implemented in Marsabit County, northern Kenya; its location is illustrated in Figure 1. The county covers an area of 70,961 km^2.

Figure 1: Map of Kenya indicating county boundaries. Marsabit County is shaded pink.



System components

The system comprises a cloud server linked to a series of data collection phones operated by field veterinarians based at the sub-county locations. It has a sub-component for abattoir surveillance operated by meat inspectors in the various slaughterhouses.

The veterinarians collect animal health data during their routine active surveillance missions including participatory disease search, or via telephone contacts with CDRs who are based at the manyatta/village and have been trained on syndromic surveillance. Using the data collection phones, the sub-county veterinarians record received data and submit them to the online server. The online server has automated scripts that processes and analyses the data as it receives and generates trends in syndromes or diseases in tables, maps or graphs which can be used by the County veterinarians to guide implementation of responses. It also generates a word cloud which identifies the commonly reported syndrome, clinical signs or phrases using a text mining algorithm.

The system also generates a county-wide biweekly bulletin which is shared among the various stakeholders as well as data collectors within a county.

Initial results

Animal health surveillance

With respect to livestock diseases and syndromes, the system has captured a total of 130 reports over the last six months. The number of reports by sub-county varies from 65 in Laisamis, 46 from Moyale, 14 from Saku and 5 from North Horr. A dashboard has been set up for illustrating the number of reports received from each reporting centre.

(i) Word cloud

The common syndromes captured in the word cloud for all the animals combined include coughing, severe breathing difficulties, mucoid nasal discharge and weakness (Figure 2).

Figure 2: Word cloud showing the frequency of reported syndromes over the 6-month period.

(ii) Morbidity and mortality trends

Additional results showing morbidity and mortality trends in cattle and small ruminants have been generated by the system. Although these can be re-analysed to show the incidence of each syndrome or disease, the system currently lumps all the reported incidences into morbidity and mortality reports. Morbidity and mortality trends observed in cattle and sheep are shown in Figures 3 and 4, respectively.

Figure 3: Morbidity and mortality reports in cattle reported between March and December 2017.

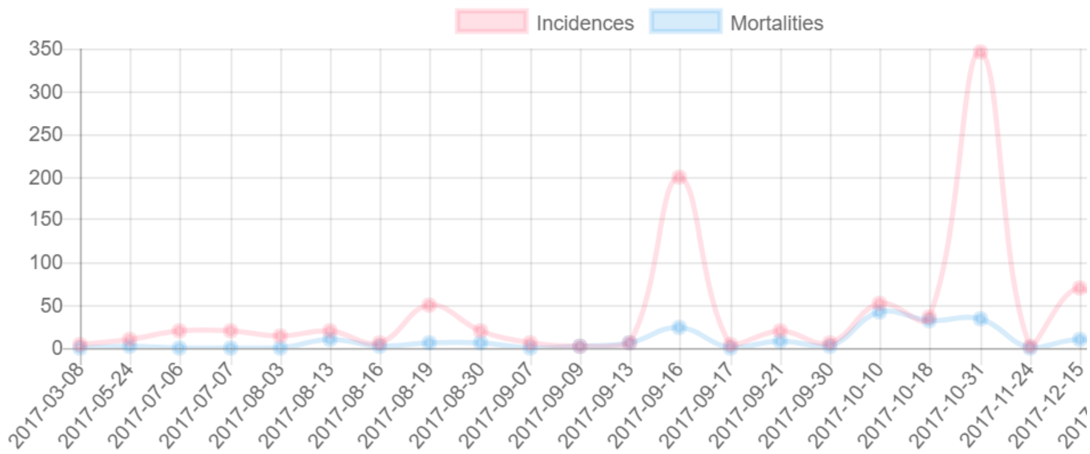
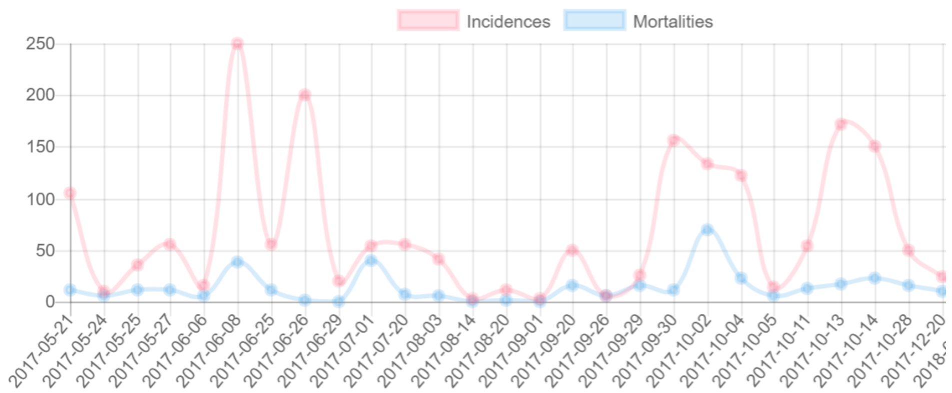


Figure 4. Morbidity and mortality reports in sheep reported between May and December 2017.

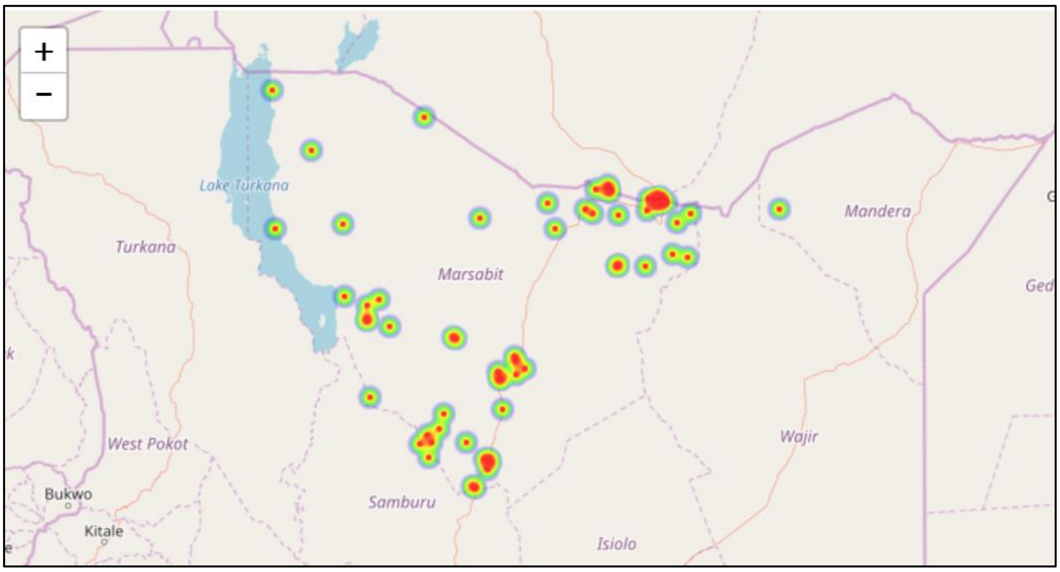


In general, the graphs show that there were increased reports of sick cattle in September and October 2017. In sheep similar patterns were observed in June and October 2017. More analyses will be done to find factors that influenced these occurrence (such as meteorological factors).

(iii) Heat maps

The system maps the location of each reporting centre and generates a heat map to illustrate the density of reports received from each location. The current trend, given in Figure 5, suggests that most of the records are received from Laisamis and Moyale sub-counties (as indicated earlier). This is a good illustration that can be used in subsequent trainings to highlight centres that need to improve their reporting frequencies.

Figure 5: Heat map showing the locations of reporting centres.



Abattoir surveillance

The numbers of cattle slaughtered and inspected in the County abattoirs in the months of September, October and November 2017 were 178, 212 and 203, respectively (Table 1). The combined numbers of sheep and goats slaughtered during the same period were 989, 1078 and 1011, respectively. Cases reported from post mortem inspections in the abattoirs in all the animals, in decreasing order, were pneumonia, fascioliasis and abscesses.

Table 1: Types of cases observed during post mortem inspection in the abattoirs and proportion of cattle and sheep and goats that had each condition

Case	Cattle			Sheep and goats		
	September	October	November	September	October	November
Abscesses	1.7%	2.8%	4.4%	0.8%	0.7%	0.9%
Fasciolosis	17.4%	15.1%	5.4%	0.3%	0.4%	0.0%
Pneumonia	0.0%	22.2%	15.3%	11.1%	11.8%	12.1%
Cysts	0.0%	3.3%	4.4%	-	-	-
Oesophagostomosis	-	-	-	0.5%	0.6%	0.6%
Stelesia hepatica	-	-	-	5.2%	2.9%	0.9%
Total number slaughtered	178	212	203	989	1078	1011

Discussion

The electronic syndromic surveillance system presented here has enabled the county to collect and analyse syndromic surveillance data collected by the CDRs at the village level and meat inspectors in all the abattoirs in the county. The strength of the system lies in its ability to conduct automated data management and descriptive analysis as a preliminary data processing step that might be invaluable for decision makers. Plans are underway for more statistical analyses that would lead to the production of risk maps for multiple syndromes and diseases. Additional geospatial data that will be required for these analyses will be obtained from online GIS databases.

The initial results obtained from these analyses demonstrate the usefulness of combining animal health surveillance at the community level and slaughterhouse surveillance for triangulation purposes. Many animal health cases reported were due to coughing, severe breathing difficulties and weaknesses. No traceability systems were used to link abattoirs and communities where animals were sourced from, but it is apparent that most of these cases could be due to pneumonia, a common post mortem finding in the slaughterhouses. More training will be offered to both abattoir meat inspectors and CDRs on how to improve the accuracy of the diagnoses/reports they give for completeness. The area is endemic for both contagious bovine pleuropneumonia and contagious caprine pleuropneumonia and it is possible that their infections are reported as pneumonia during post mortem inspection.

There is still a lot of room to improve the existing surveillance system by increasing sources of surveillance data. Other potential sources that should be considered include livestock markets, agro-veterinary drug stores and conservancies. Thus far, the system has improved the existing collaborations between field veterinarians, CDRs and pastoralists. The online database developed provides the county veterinary staff with a reliable and accessible repository for managing large volumes of data (big data) which hitherto was being stored without any analyses in the traditional veterinary rumour registers and ledger books. In future, the system is expected to substantially reduce the response time as the types of clinical cases and syndromes reported and their locations are made available to the disease control agents at the county and national levels.

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