A decision support tool for vector-borne disease in Queensland, Australia

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Ross River virus (RRV) and Barmah Forest virus (BFV) are the two most prevalent mosquito borne diseases in Australia. To lessen their burden on public health, prevention through vector control and public awareness is integral as there are no treatments or vaccines currently available. In many geographical areas there are clear relationships between climatic variables and RRV or BFV disease incidence,[1-5] creating the potential for climate-based early warning systems. Such systems could be used to guide mosquito control activities. However early warning system accuracy and adequate intervention is unlikely to entirely counteract increased disease activity. For this reason early detection of increased RRV and BFV activity remains important.

RRV and BFV cases are reported to the National Notifiable Disease Surveillance System (NNDSS) via the Australian state health departments,[6] while mosquito control activities are typically the responsibility of local government. However there is currently no routine mechanism for disease data to be transferred from the NNDSS, or the state managed notification databases, to local government. To address this deficiency we developed the Vector-borne disease Early Detection and Surveillance (VEDS) System, a web-based disease monitoring system that currently operates in Queensland.

The VEDS System uses de-identified data collected by the Queensland Health Notifiable Conditions System (NOCS); data are extracted weekly and imported into the VEDS System. Current and historical notification data are categorised by local government area (LGA) of residence, age (5-year groupings), gender and week of disease onset. Outbreak alert thresholds are calculated using the 95th percentile of the Poisson distribution centred around the expected number of notifications within each week and LGA.[7, 8] The main focal point of the software is a plot displaying current numbers of notifications compared to the usual transmission for each LGA. Notifications are coloured coded depending on whether disease levels are categorised as normal or outbreak (Figure 1). To complement the graphical representation, a map displays LGAs currently or recently experiencing outbreaks and

allows for the easy identification of geographically widespread disease activity. As the VEDS System is a passive system requiring users to log on to monitor disease trends, we included an option for users to receive an automatic email message when notifications in their nominated LGA exceeded the alert threshold. This is a technically simple but effective way of ensuring that users are informed of potentially significant events.

The VEDS System was released to all local governments in Queensland in August 2010. An updated version of the site (VEDS2) was released in April 2012; at this time there were 74 registered users from Queensland Health, Queensland local government and federal health authorities. In October 2012 we conducted an online survey of VEDS2 users from local and state government to enquire about patterns of usage and impact on decision making practices. Although the individual response rate was low (19%), feedback was obtained from approximately half of the organisations registered to use VEDS2. Most respondents indicated that they logged into VEDS2 as part of their normal duties (54%), while a smaller proportion (38%) did so when there was suspected virus activity, they received an email alert or climate conditions seemed favourable to transmission. Twenty-three percent of survey respondents indicated that they had altered their activities in some way after receiving a VEDS alert; the most frequent action reported was a more concentrated inspection of known breeding sites. State government users indicated that following an alert they often engaged with the relevant local governments about the problem, assisting when needed in coordinating additional vector control activities and the release of public health advisories. Those users that had not altered their plans stated they may if a large significant outbreak event occurred. Thirty-one percent of the respondents used the VEDS System in conjunction with other tools such as mosquito surveillance data, climate conditions and larval sampling.

As with all surveillance systems the VEDS System is limited by the delay between the onset of illness and data availability. A retrospective analysis indicated that 92.3% and 89% of

notifications for BFV and RRV diseases, respectively, were accessible on VEDS within 2 weeks of illness onset. These rates were consistent across the Queensland LGAs and are satisfactory for the target diseases since outbreaks typically develop over several weeks and tend to last for several months.[4, 7]

We believe that the VEDS System improves the utilisation of routinely collected notification data by ensuring that disease specific data are available promptly in a user-friendly format with increased interpretability. This is the crucial link when those that hold the responsibility for vector control are a different authority from those that record the disease data. Developing a set of decision-support tools including early warning and detection systems, as well as other complementary surveillance data can only assist with curtailing mosquito borne disease through scheduled vector control, emergency vector control and carefully timed public health warnings and campaigns.

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Figure 1. Reports page screen capture of the VEDS2 System. Each bar represents the number of notifications within the current 3 week moving window (3-week moving window finishes at end of the indicated week) and is colour coded according to whether it is above (red) or below (blue) the alert threshold. The green line is the expected number of notifications and the red line is the alert threshold. Weeks are numbered starting from 1 January in 7 day increments (ie Week 1 = 1st – 7th January).