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Stop The Bugs:
A Maven-Based Solution For Public Health Vector Surveillance

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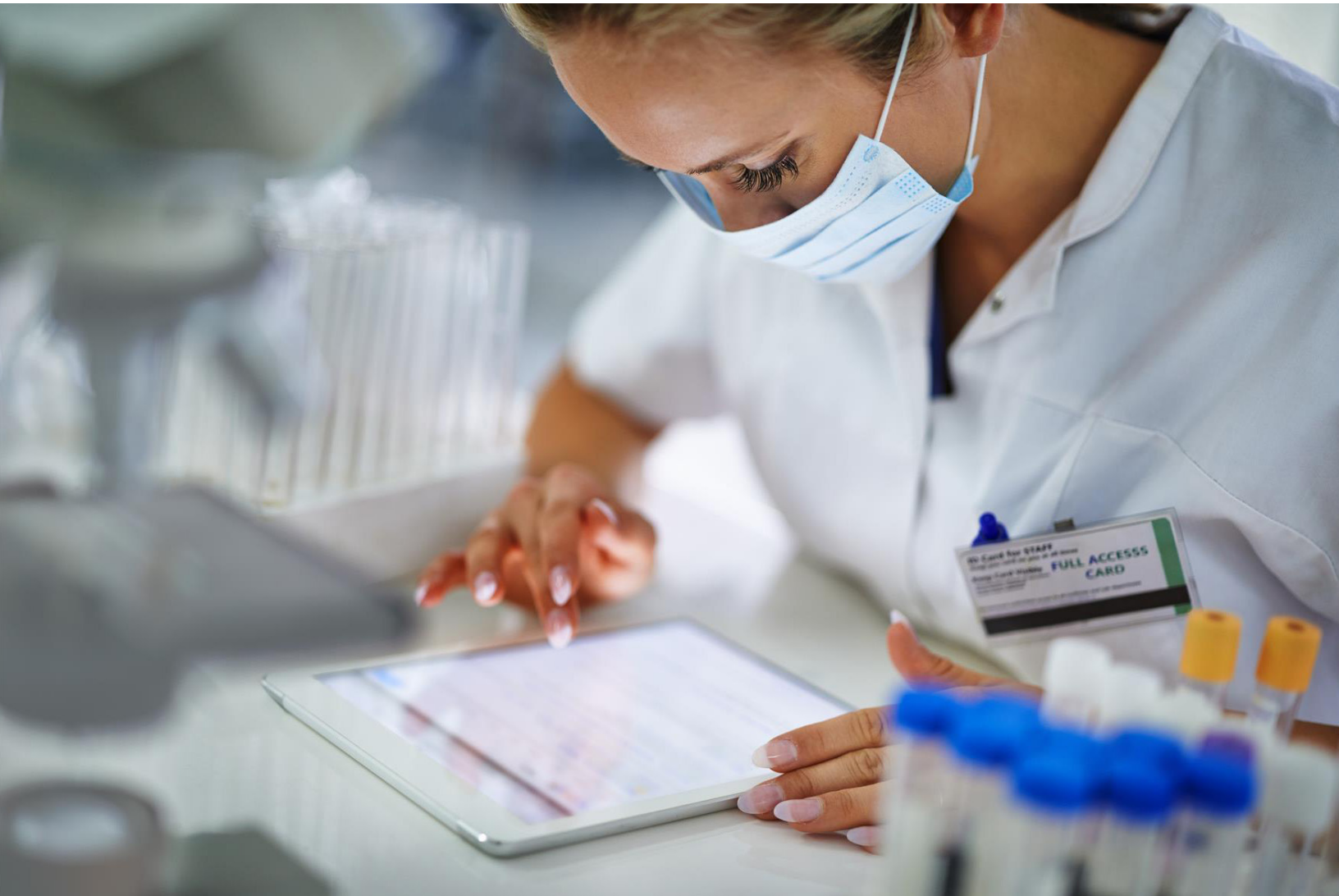

Vector-borne disease prevention requires a vector management system that is integrated within and across public health surveillance systems

Executive Summary

Vector management is the primary prevention and control of vector-borne disease outbreaks. Vector management is a complex dynamic process requiring integrated surveillance with cross-sector communication and collaboration. While the science of disease prevention and control has progressed, the software tools to support these efforts have not kept pace – until now.

The problem

The problem lies in disjointed public health surveillance systems. Fragmentation of vital information increases the risk of preventable disease outbreaks.

The solution

The solution is a cohesive synergy between three public health tracking systems:

- Vector surveillance
- Infectious disease surveillance
- Prevention case-management

Based on the proven Maven case management software platform, we have designed a robust Vector Surveillance module that provides infectious disease public health professionals the specific parameters required for effective vector management and integrates the management and prevention of vectors and vector-borne diseases.

The Vector Surveillance module addresses time-sensitive epidemiological triad questions; models for static and dynamic vector-host-environment relations; and disseminates information in real-world language for diverse stakeholders.

For example, vector surveillance field personnel and case investigators can easily enter collected data remotely using Maven's mobile interface. Maven has the flexibility to adapt data collection and lab reporting according to vector type, such as inbound HL7 lab reports and aggregated result surveys. Maven's configurable rule engine then analyzes the data and organizes it into events or cases to be routed for further investigation or simply counted in surveillance reports. Addresses and latitude/longitude positions in the data can be used to generate geospatial reports showing geographical proximity of vector collection sites and human disease cases. With a cloud-hosted Maven system, the data becomes available anywhere and anytime for review, update, and analysis. Offline Maven allows for remote data collection without the need for internet connectivity. Offline data is then loaded into the system upon reconnecting.

Is Your Vector Surveillance System Analogous To Herding Cats?

Imagine the typical scenario. Your Environmental Public Health program gets calls, emails, website inquiries from the public reporting complaints about the number of dead birds in their neighborhood, or excessive swarms of mosquitoes. You have no efficient means to determine the geographical location of these concerns. So, you have your vector control specialist contact the parties again to retrieve the needed information to conduct field visits

At the same time the county Housing Authority is getting complaints of abandoned homes with old tires and wash basins harboring mold, mildew, rats, and mosquitoes. You find this out two weeks later at a new interagency task force meeting aimed to improve agency communication. You wonder if these homes are in close proximity to where the vector control specialist conducted field visits.

Later in the week you read in the newspaper that the new urgent care facility in the Hospital district saw an unprecedented number of individuals with symptoms associated with West Nile Virus. You wonder if this is reporting bias due to the new facility or is a true outbreak. And did these cases live in the same area where the vector control specialist conducted field work and where the abandoned homes lie. But you cannot find this information out quickly because the infectious disease epidemiologist has not linked your data with the Human Services database and the reportable disease registry.

Pulling together the various sources of data from different reporting systems can seem as inefficient and ineffective as herding cats.

Moreover, this type of organizational structure makes it difficult for an Environmental Public Health system to fully excel in the 10 essential Environmental Public Health services. The Centers for Disease Control and Prevention state “these services describe the collective set of capacities and activities necessary in an Environmental Health System or program to effectively support the provision of services and programs needed to improve and protect environmental health”.

As our world continues to shrink, mosquito control in the United States will assume a more critical public health function.

— American Mosquito Control Association

10 Essential Environmental Public Health Services

1. Monitor	Monitor environmental and health status to identify and solve community environmental public health problems.
2. Diagnose and investigate	Diagnose and investigate environmental public health problems and health hazards in the community.
3. Inform, educate, empower	Inform, educate, and empower people about environmental public health issues.
4. Mobilize	Mobilize community partnerships and actions to identify and solve environmental health problems.
5. Develop policies and plans	Develop policies and plans that support individual and community environmental public health efforts.
6. Enforce	Enforce laws and regulations that protect environmental public health and ensure safety
7. Link	Link people to needed environmental public health services and assure the provision of environmental public health services when otherwise unavailable.
8. Assure	Assure a competent environmental public health workforce
9. Evaluate	Evaluate effectiveness, accessibility, and quality of personal and population-based environmental public health services.
10. Research	Research for new insights and innovative solutions to environmental public health problems

In order for Environmental Public Health systems to excel in the provision of the 10 Essential services, the following fundamental system functionalities were noted:

- Utilize appropriate methods and technology to collect, store, manage, and interpret data.
- Collaborate among all environmental health system partners to share data to track changes in environmental conditions that potentially impact environmental and human health.
- Conduct community environmental health assessments every 3 years.
- Develop policy to protect public health from environmental factors, promote ecological balance important to human health, and guide the practice of environmental health within the community.
- Conduct systematic community-level and state-level environmental health improvement and emergency response and preparedness plans.

The distribution of vector-borne diseases is determined by a complex dynamic of environmental and social factors.

— World Health Organization

- Assure all prevention, intervention, and enforcement activities are conducted in a timely manner in accordance with laws, regulations, and ordinances.
- Inform and educate individuals, organizations, and regulated entities of the meaning and purpose of public health and environmental quality laws, regulations, and ordinances.
- Identify communities that may experience barriers to the receipt of vector management services.
- Develop referral mechanisms to link populations to services to optimize access.
- Evaluate services against established criteria for performance.
- Utilizes evaluation results to modify (vector management) activities to address identified deficiencies.
- Assess the effectiveness of communication, coordination, and linkage among stakeholders.

Where The Bugs Lie

The siloed Public Health Vector Surveillance systems present challenges across multiple system domains related to vector management that impede the system capacity to provide the 10 Essential Environmental Public Health services. Based on a systematic review of Vector Management programs, the following surveillance system challenges were noted:

Data collection

- Type of vector: an efficient and effective system involves a sub-species infrastructure and related data collection variables to tailor investigation processes and disease prevention and control actions.
- Integration between surveillance systems: integrated system that allows for cross talk between programs in the ability to provide comprehensive view of the problem to enable targeted prevention measures and vector management and disease control.
- Track prevalence measures: vector infection rate; the percentage of viremic hosts or recent sero-conversions in sentinel birds or horses; different vector life-cycle stages.
- Track control measures: environmental spraying; container reduction campaigns; community education prevention outreach.
- Geospatial Mapping: latitude and longitude of disease cases – human, host, and vector, including trapping and control.

Processing

- Business processes to initiate vector data collection: automated vector surveys disseminated among community members responsible for vector testing and control.
- Time management: automated work lists/flows with decision support to help streamline business processes.
- Data integrity: automated validation checks with user alert to correct inconsistencies and structured data reducing reporting errors.

Utilize appropriate methods and technology to collect, store, manage, and interpret data.

- Automated linkage of vector species to disease type and vector control plan: identification of the vector species to activate the requisite control plan that is known to reduce the risk of the vector-borne disease.

Reporting

- Integrated reporting: combine data fields from the various components of vector management and control to provide a comprehensive evaluation of the burden of disease.
- Timely reporting: real-time data reporting to meet CDC/state reporting times.
- Quality assurance reports: response times for vector complaints and subsequent vector control actions.
- Geospatial Mapping: integration of layered information to visually evaluate correlations between environment, topography, disease counts, vector counts, population density, control activities.
- Statistical analytical capabilities: export data in formats for analytical software program import.
- Basic inferential statistical reports: customized summary statistics reports.

Communication

- Communication of treatment and enforcement activities: streamline communication to relevant stakeholders through documented formal protocols and established communication flowcharts.
- Notification of potential vector-borne disease cases: information exchange with external stakeholders.
- Mass communication tools: approved communication print templates for diverse audiences.
- Real-time inter- and intra-agency messaging: cross-collaboration between infectious disease departments, labs, and community partners to facilitate efficient and effective information exchange.
- Referral mechanism: link community members to vector control services.

Prevention Case-Management

- Tailored vector counter-response plans: vector-specific counter-response plans.
- Tailored vector-borne disease counter-response plans: plan is contingent on the type of vector and magnitude of the disease outbreak, and composition of the human and animal population distribution and density.

Evaluation

- Community outreach assessment: determine vector-related issues.
- Monitor: determine vector population parameters and determine vector population thresholds.
- Evaluate: vector control strategies and vector patterns.

System Usability

- Time: update/revise forms, information, contacts, response plans and protocols.
- Processing speed: ability to respond to unexpected outbreaks/incidents while still completing necessary zoonotic disease follow-up to incidents.
- Interface: program website and vector surveillance system.
- Scalability: operational capabilities to communicate with other systems or run analytics efficiently.
- Accessibility: access the raw data to run ad hoc analyses.

www.wvdhhr.org/envhealth/index.htm
www.cdc.gov/nceh/ehs/envphps/docs/envphpsv2.pdf
www.phf.org/resourcestools/Documents/Vector_Control_Report_Final_Document_with_TOC.pdf

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