How to Manage an Outbreak: The Pillars of Outbreak Response

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We provide here a description of the principles of effective outbreak management that we refer to as The PIllars of Outbreak Response (Pillars). The approach is applicable to outbreaks of all sizes and durations and includes not only those of infectious diseases but also chronic disease and socioeconomic determinants and outcomes. These include issues like poverty, homelessness, inflation, governance failure and countless others. The approach outlined here provides:

1. A description of the outbreak management process
2. A strategic plan for management of any outbreak
3. An evaluation framework for response to outbreaks in progress

The Pillars of Outbreak Response

Pillar 1 Leadership:

PIllar 1 consists of creation and management of the outbreak leadership team. Outbreak management is inherently practical. The objective is, usually, to discover the cause of the outbreak and eliminate it in the short term, treat affected people/ animals and address collateral damage, and put in place measures to prevent future outbreaks. Unlike academic research or broad 'policy' interventions, the objective is usually eminently clear and the effectiveness of the players is often on very public display. It should be led by people with practical experience in outbreak response and include all relevant stakeholders. It should also be guided by values of collaboration, transparency, evidence-based decision making and and focus on rapid resolution of the outbreak - not personal or institutional gain. The leadership team is almost invariably the key element that distinguishes success from failure.

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Pillar 2 Information and Data:

Pillar 2 consists of obtaining and correctly analyzing and interpreting all relevant information and data required to find the cause(s) of the outbreak and devise rational interventions that address all relevant outcomes. This includes 1) peer-reviewed literature, gray literature, media reports and interviews with experts/ key informants (including those working at the ground level) and 2) secondary databases (eg those created for administrative or research purposes) and primary data sources (ie those collected specifically for management of the outbreak). Data analysis is used to determine the nature and extent of the outbreak and to determine its causes(s), for example through statistical analysis. It is also used to determine performance characteristics of relevant tests such as sensitivity, specificity and predictive values.

Pillar 3 Interventions:

PIllar 3 consists of devising, implementing and evaluating potential interventions. The specific interventions naturally depend on the nature of the outbreak (eg infectious vs chemical, economic etc). They are guided by information and analyses undertaken in Pillar 2. Interventions are typically implemented sequentially, beginning in the short term with those that seem plausible to be effective and which have a low probability of harm or cost. As more data are gathered and initial interventions evaluated, these are often followed by interventions that are more specific, perhaps more costly and which require more time to implement.

Pillar 4 Communication:

PIllar 4 consists of establishing a process for communication that is complete, factual, transparent and multi-directional and which involves all required stakeholders including the public. Vehicles for communication depend on the situation including face-to-face and video/ phone meetings, media and social media, flyers, public meetings and so on. In each case, the messaging should be coherent, consistent across sources, and easy to understand.

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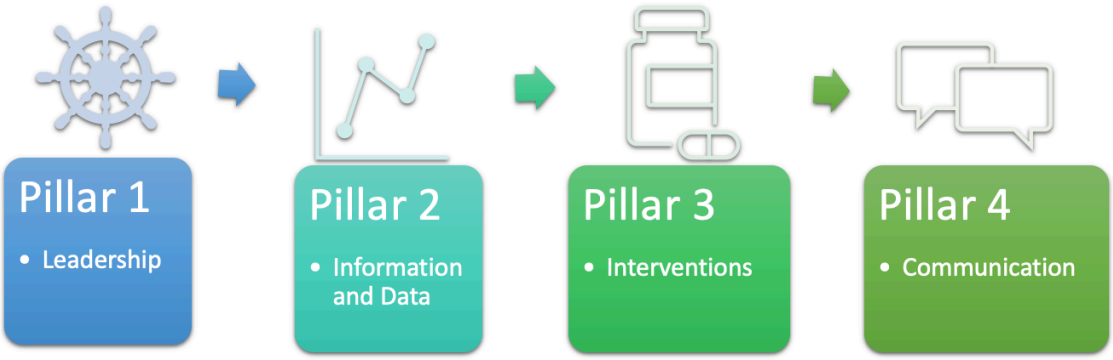

Management of the Pillars: Community Network Integration (CNI) and Quality Management (QMS)

Running an outbreak response can be a complex endeavor, involving distributed networks consisting of many different people, approaches and resources. Like any project, its success is limited by the effectiveness of its management processes.

The most effective process for managing complex projects is Quality Management Systems (QMS). Most QMS are used to manage networks of limited scope, particularly corporate value chains. To our knowledge the only validated and evidence-based process to manage large distributed networks is Community Network Integration, along with its unique distributed QMS.

CNI has been used to manage multiple outbreaks or components of them.Its administrative functions (Table 1) are drawn from standard business best practices, but with modifications to support optimal distributed network functioning. These are discussed in the case study, below.

Table 1. Administrative functions for management of outbreaks and other projects, under CNI.

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- Mission, Vision & Values
- Leadership & Governance
- Culture
- Human Resources
- Marketing, Sales, & Fundraising, Communications
- Products, services and projects
- Physical infrastructure
- Finance
- Legal
- Information Technology
- Administration
- Quality Management

Case study: The Walkerton Waterborne Illness Tragedy

Prior to Covid, arguably the best known outbreak in Canada was the Walkerton waterborne crisis in which seven children died following consumption of drinking water contaminated by *E. coli* O157:H7 from a faulty municipal well.

Successful resolution of the outbreak followed what is now known as the Pillars approach. The outbreak team (Pillar 1) was, importantly, led by individuals with extensive practical training and experience in outbreak response. It included all relevant stakeholders, and deliberately sought to create a culture of collaboration, transparency, evidence-based decision making and effective communication. The focus of the team was squarely on rapid resolution of the outbreak - not personal or institutional gain. The team held regular weekly meetings with key stakeholders and transparently shared information required to manage the situation under established principles of good governance and leadership.

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With an initial leadership team established, an operational team was created and Pillar 2 (information, data and analyses) began. Peer reviewed papers, reports etc were assembled and shared and experts were consulted on everything from tests for *E. coli to* risk factors for infection, outbreak management etc. Experts and local individuals were consulted. Surveillance for cases was begun through local doctors offices, pharmacies etc with the collaboration of local media. A standardized questionnaire was administered to cases and randomly selected controls to obtain information on 1) health outcomes 2) risk factors and 3) demographic information. Regression analysis helped to rule in municipal water as the outbreak source, including the specific well involved and helped to rule out other potential sources of infection.

PIllar 3 (interventions) was based on analyses from Pillar 2. It included 1) an initial boil water advisory 2) subsequent decommissioning of the offending well and 3) a province-wide review of all small communal water systems and requirements for testing and remediation.

Throughout the outbreak, communications were coordinated by the leadership team as described above (PIllar 4). It was, for the most part, complete, honest, transparent and multi-directional and involved all required stakeholders including the public. Local and national media cooperated with the outbreak team to assist in the outbreak response. Every effort was made to develop messaging that was coherent, consistent across sources, and easy to understand.

The outbreak was also managed in a manner consistent with the administrative functions outlined in Table 1. Mission, leadership, governance, culture, human resource mobilization and the outbreak response activities (ie products, services, projects in Table 1) have been discussed above. A coherent legal framework was instituted including engagement of the services of relevant legal experts and police. Information technology used during the outbreak was primarily off the shelf. However, experience gained in the outbreak, in part, led to the development of a national IT platform for outbreak management (Canadian Network for Public Health Intelligence - CNPHI). The lessons learned from Walkerton helped to inform what later became codified explicitly as the PIllars, CNI and its QMS framework.

Canada (and the world) continue to experience outbreaks of infectious diseases (eg Covid, Avian Influenza, African Swine Fever), chronic disease (eg diabetes, cancer, cardiovascular disease) and socio-economic outcomes (eg poverty, addiction, homelessness). Each of these must be managed through the PIllars approach and CNI (or equivalents) under a Quality Management System to be resolved successfully. Table 2 provides questions to assist the

reader in reflecting on the effectiveness of current and potential future outbreaks with which they may have familiarity - and how to improve the outbreak response, including their own role.

Table 2. Questions for reflection on outbreaks in progress

1. PIllars
    a. Does an effective and active outbreak team exist as defined above?
    b. Do we have a complete, centralized and shared data and information framework for managing the outbreak? What is missing and how can we infill the gaps? Is the information actually being used to guide interventions and communications?
    c. Are the interventions being attempted consistent with the evidence? Is there an evaluation framework for them that is being used to guide modifications? Are interventions being prioritized and implemented sequentially (short, medium and long term) and evaluated/ modified in a timely manner?
    d. Is internal and external communications appropriate as defined above? What changes need to be made to the communication strategy?
2. CNI Administrative Functions
    a. Is the leadership team ensuring that the network is being led and managed coherently according to known principles of business effectiveness (Table 2)?
    b. What are the gaps that are limiting our effectiveness? How can they be rectified?
    c. Is the outbreak response being managed under a Quality Management System? How can we do so and/ or increase its effectiveness?
3. Your own leadership
    a. What am I doing to help resolve this outbreak?
    b. Are there ways I could Improve? Are there ways my team could improve?
    c. What resources could I draw on to assist me and my team?

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