

# **Defining “Critical Mass” for Ontario Public Health Units**

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# Defining “Critical Mass” for Local Public Health Agencies in Ontario

## Introduction

The Ministry of Health and Long-Term Care (MOHLTC) has established a Capacity Review Committee (CRC) to assess the critical factors that must be addressed to improve the ability of local public health units<sup>i</sup> (PHU) to effectively respond to the current and emerging needs of Ontarians. To facilitate their work, the CRC has struck a series of sub-committees including one focussed on the governance and structure of PHUs. Preliminary discussions among this sub-committee have identified the need to describe the critical mass required of these organizations.

The concept of critical mass permeates recent system infrastructure documents. For example, in a CIHR report entitled *The Future of Public Health in Canada: Developing a Public Health System for the 21<sup>st</sup> Century*, it states:

“There needs to be a sufficient population base for a critical mass of technically expert staff to be effective.”<sup>1</sup>

Similarly, the federal post-SARS report, *Learning from SARS: Renewal of Public Health in Canada*, highlighted the importance of critical mass and public health human resources:

“No attempt to improve public health will succeed that does not recognize the fundamental importance of providing and maintaining in every local health agency across Canada an adequate staff of highly skilled and motivated public health professionals.”<sup>2</sup>

Critical mass has been defined as “the minimum amount (of something) required to start or maintain a venture.”<sup>3</sup> In the local public health context, critical mass is the minimum amount of resources, expertise and capacity of PHUs required to fulfill expectations for performance. While intuitively the question of what a PHU needs to be might appear obvious, it may be a more difficult challenge to explicitly define it. Considering that Ontario currently has 36 PHUs with widely varying characteristics, it is far from certain

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<sup>i</sup> “Public Health Unit” (PHU) is often used to denote the local public health organization in Ontario, but in the *Health Protection and Promotion Act*, this term actually refers to the geographic boundaries of the public health organization. While acknowledging this difference, for the purposes of this paper, PHU will be used to describe the local public health organizational entity of the province’s formal governmental public health system.

that even the intuitive vision of a PHU is consistently shared among stakeholders. Defining the required “critical mass” of PHUs as clearly as possible is fundamentally important to the overall design of the province’s public health system.

The consistent message from recent post-SARS reports is the perception that there are too many PHUs in Ontario with the result that some have insufficient ability to fulfill required functions. This perception appears to have been validated by the extent of mutual aid that had to be provided to a southern Ontario PHU from several other public health units to help control a rubella outbreak in May 2005. This mutual aid included 2 Associate Medical Officers of Health, public health nurses, public health inspectors, an epidemiologist and data analyst, and a program manager. The province also transferred in communications expertise to assist the outbreak.

The purpose of this paper is to better characterize the required critical mass of PHUs in Ontario to inform decision-making of the CRC.

## **Existing Guidance/Evidence – Critical Mass of Local Public Health Organizations**

### ***Ontario***

The *Health Protection and Promotion Act* (HPPA) defines the programs and services expected of PHUs in the form of the Mandatory Health Programs and Services Guidelines (MHPSG). The MOHLTC assesses PHU compliance with the MHPSG via annual self-reporting (Mandatory Program Indicator Questionnaire – MPIQ).

The MHPSG are primarily concerned with the service outputs of PHUs. The required activities are grouped into three major program components and their constituent programs, as well as three additional general standards. The preamble of the MHPSG provides general guidance on the types of staff expected to be employed in PHUs (see text box). However, the MHPSGs do not prescribe a minimum number, staffing to population ratios or other guidance that directly inform the critical mass question. The HPPA does specify that every board of health, the governance body of PHUs, shall appoint a full-time Medical Officer of Health (MOH).

### **Staffing Expectations for Public Health Units (MHPSG)**

Boards of health are required to employ the services of appropriately trained professionals. This should be consistent with any qualification requirements of the Health Protection and Promotion Act and Ontario Regulation 600/91, Qualifications of Boards of Health Staff, in respect of: medical officers of health, public health dentists, dental hygienists, public health inspectors, public health nurses and public health nutritionists. Also, boards of health will employ staff with training in epidemiology, health promotion, speech pathology, toxicology and other backgrounds that are appropriate for interdisciplinary program planning and effective program delivery.

The services provided by boards of health are expected to be planned and delivered by staff with both the required technical/professional skills (acquired through the qualifications listed above) as well as skills in the following areas:

- community needs assessment
- risk assessment and communication
- policy development/analysis
- program planning
- program evaluation
- data management
- data analysis
- case management
- counselling
- immunization practices
- infection control
- health hazard investigation and assessment
- negotiation and mediationhealth promotion:
  - community development
  - social marketing
  - mass communication and media
  - health education
  - adult education
  - peer education
  - behaviour change education
- enforcement
- emergency planning
- advocacy

### ***Other Canadian Provinces***

With the exception of Quebec, other provinces are less explicit than Ontario regarding the programmatic and structural expectations for public health. The responsibilities of local public health agencies (LPHA) are embedded within regional health authorities (RHA) so that the number of LPHAs is dependent on, and equivalent to, the number of RHAs in a province at any given time. Achieving the required critical mass for local public health entities within RHAs has not been a system design criterion. Public health staff are not always organized as a single entity as this is left to the discretion of individual RHAs in most provinces. In the absence of consistent structures, mandated programs and monitoring of performance, public health systems in other provinces provide little guidance on the concept of critical mass.

### ***England***

In England, public health was recently restructured to adapt to a major reorganization of their National Health Service (NHS). At the local level, public health has been spread out

from 90 pre-existing health authorities to over 300 Primary Care Trusts (PCT). Concerns for a loss in critical mass has prompted the creation of networks for mutual support, regional Public Health Observatories to assist with population data analysis and application; and local communicable disease control teams becoming affiliated with the newly established Health Protection Agency instead of being part of the PCTs. Performance of the public health component is not captured specifically, but is embedded within broader accountability frameworks of the PCTs.

Recent communication with key informants from England indicates that the fragmentation of local public health staff both inside and outside the PCT has been particularly problematic. Concerns that there was inadequate critical mass when there were 90 health authorities were not improved with a shift to the more numerous PCTs. According to the key informants, the NHS intends to transform the PCTs into 50 new health authorities with an average population base of 1 million.

### ***United States (U.S.)***

In the U.S., there has been substantial interest in the issue of the capacity and performance of LPHAs. The National Association of County and City Health Officials (NACCHO) has been actively developing, through consensus, an operational definition of a LPHA. The goal of the project is a shared understanding of what people in any community, regardless of size, can expect their LPHA to provide. As of April 2005, high level standards have been drafted for each of the country's 10 essential public health services. These standards appear to be highly consistent with the National Public Health Performance Standards (NPHPS) for local public health systems, which were developed by the Centers for Disease Control and Prevention (CDC) in partnership with key national public health groups. They are comprised of statements of expectations (the standards), indicators, and assessment questions. CDC hopes to have the assessment instrument implemented in all states by the end of the decade.

Over the past 12 years, there have been multiple studies conducted in the U.S. attempting to provide information to inform the relationship between the organizational structure of LPHAs and their performance. This literature will be briefly reviewed.

#### **National Study – 1993**

Handler and Turnock used a set of 10 performance measures based on the 3 high level functions of public health (assessment, policy development, and assurance)<sup>4</sup> that had been developed by the CDC Public Health Practice Program Office and were adapted for the survey.<sup>5,6</sup> The responses were correlated with a NACCHO survey of LPHAs. Data from both surveys were collected in 1992-1993. An effective LPHA was defined as one meeting the majority of performance measures for each function. Response rate to the performance measure survey was only 43%. Only 15% of the responding 264 LPHAs met the criteria for being effective. Table 1 provides a summary of key organizational variables from this study.

**Table 1: Association of Organizational Characteristics with LPHA Performance, U.S., 1993**

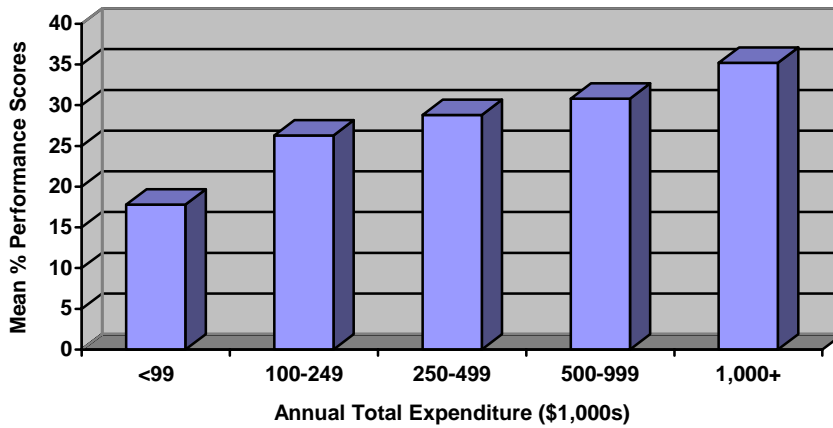
<b>Measure</b>	<b>Defined by</b>	<b>Odds of Meeting Performance Criteria (p-value)</b>
Jurisdiction size	Larger vs. smaller than 50,000	OR=1.44 (ns)
Leadership	Full-time vs. part-time	OR=2.91 (0.03)
Annual expenditures	\$1million+ vs less	OR=2.35 (0.01)
Total staff	50+ vs. less	OR=2.48 (0.007)
Presence of board of health	Yes vs. no	OR=0.96 (ns)

Source: Calculated from data provided in Handler and Turnock, 1996<sup>6</sup>

Both budget size and staff numbers were associated with increased performance. Jurisdiction size is also presumably related to these other 2 variables, but did not reach statistical significance. Full-time leadership was also significantly associated with performance. Results are limited by the low response rate, crude self-assessed measures of effectiveness, and the jurisdictional size threshold being set extremely low.

Suen et al. re-analyzed this data using a somewhat different set of core functions that were then scored on a 100-point scale.<sup>7</sup> In their analysis, performance scores were consistently better for those LPHAs that served populations greater than 50,000 compared with smaller LPHAs for each of the 8 core functions. Analysis by total annual expenditures also showed a monotonic relationship between expenditures and mean performance for each function as well as overall performance (Figure 1). It is noteworthy though, that even the organizations with the largest expenditures had average performance levels that were less than 40% of the standard.

**Figure 1: Mean Performance Scores of LPHAs by Total Annual Expenditures, U.S., 1993**

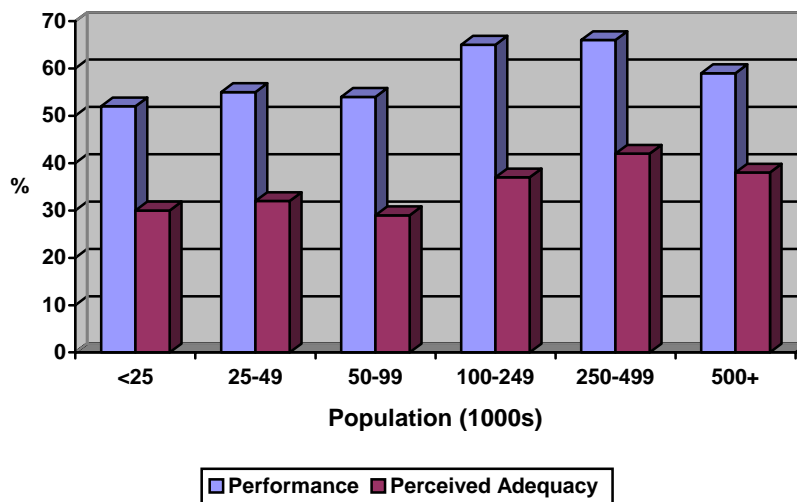


Source: Suen et al., 1995<sup>7</sup>

**Six States – 1993**

A study by Richards et al. similarly used a 10 item scale to assess the performance of the high level public health functions in six states: Alabama, Maryland, New Jersey, Wisconsin, South Carolina, and Mississippi.<sup>8</sup> A 94% response rate was achieved. Limited information is provided regarding organizational characteristics, but the article does provide performance data by population size served (Figure 2). Increased performance tended to occur in LPHAs with populations greater than 100,000, perceived adequacy peaked in LPHAs with greater than 250,000 population.

**Figure 2: Association of LPHA Performance and Population Size, Six U.S. States, 1993**





Source: Richards et al., 1995.<sup>8</sup>

Information is also provided in the publication on local-state relationships with decentralized models showing on average, higher performance than local independent models. The study appears limited by self-assessment, crude measures, and limited information on organizational characteristics

### **National – 1998**

Another national assessment of organizational characteristics and performance occurred in 1988, but focussed on LPHAs serving populations of 100,000 or more.<sup>9</sup> The 3 high level functions were assessed through an expanded self-assessment instrument containing 20 items. The study achieved a 71% response rate.

Availability of services was greater with larger population sizes, lower poverty rates, and higher public health per capita spending. Regression analysis observed that a 100% increase in population was associated with a 7% increase in the proportion of activities performed.

### **New Jersey – 1998**

This state-specific study utilized a questionnaire assessing structure, core function performance, personnel resources, communication capabilities, and public health activities.<sup>10</sup> The response rate among LPHAs was 88.7%.

They observed that overall performance of the core functions was not associated with structure, population size served or size of budget. However, the assessment function was associated with larger budgets and larger population sizes. The study is limited by self-reporting and the lack of publication of data tables for any of the performance results.

### **Wisconsin – 1999**

This state-specific study focussed specifically on compliance with statutory and administrative rules.<sup>11</sup> The State of Wisconsin has three levels of certification of LPHAs, which were found to be associated with overall compliance rates (Table 2). Larger organizations serving larger populations had higher average compliance rates.

**Table 2: Compliance with Statutory and Administrative Rules, Wisconsin, 1999**

	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>
Population (mean)	21,333	43,589	117,502
Staff (FTE)	6.6	11.3	46.9
Per capita expenditures	15.17	15.72	20.90
Overall compliance (range)	0.82 (0.31-0.93)	0.89 (0.77-0.94)	0.92 (0.87-0.96)

Source: Zahner and Vandermause, 2003.<sup>11</sup>

### **Texas – 2001**

A pilot of CDC’s Local Public Health Performance Assessment instrument was conducted in local public health systems in Texas.<sup>12</sup> Data was available for 37 of 47 (79%) local systems. The authors described that the systems were grouped into two clusters that they labelled as “high” and “low” performance with the former having twice the level of service provision of the latter. Key differences in characteristics between the two groups of systems are shown in Table 3.

**Table 3: Comparison of High and Low Performance Local Public Health Systems, Texas, 2001**

	<b>High Performance (n=18)</b>	<b>Low Performance (n=19)</b>
Community size	250,063	50,676
Premature deaths/1,000 pop’n	71.7	77.2
Public health agency expenditures/capita	22	18
Employees/10,000 pop’n	4.4	2.7
Public health agency service provision – contributor to system performance (%)	47	26

Note: values are medians; Source: Kennedy, 2003.<sup>12</sup>

Higher performing systems served much larger communities, had greater numbers of employees, and the LPHA contributed a greater proportion of the overall public health services to local systems. Considering the discrepancy in performance, the authors questioned whether it was reasonable to expect all LPHAs, as currently structured, to meet common performance standards. While this study introduces the use of a much more comprehensive assessment tool, it is a pilot version and based on self-assessment. The data defining the high and low performance groups was not provided in the report.

### **Three States – 2001**

Similar to the preceding Texas-based report, this study applies a test version of the Local Public Health Performance Assessment instrument in three States.<sup>13</sup> The authors used organizational data collected 3-4 years earlier by NACCHO.

On a univariate basis, several variables were associated with total system performance including population size, size of workforce, per capita expenditures, expenditures per staff FTE, directors with public health training, local board of health with governing and policy making separate from elected legislative body, and affiliation with universities/academic centres. Multiple regression analysis gave preference to per capita expenditures, having a director with public health training, and partnerships with universities and businesses. The overall regression model explained 45% of the variance in system performance.

Similar to other studies, this study was based on self-assessment and used a pilot version of the assessment tool. Reliability may have been particularly impaired because a glossary had not yet been developed for terms used in the tool. Associations between organizational characteristics and performance may have been impaired since data were collected 4 years apart. The multi-variate analysis was not guided by a conceptual model.

### **Washington State**

The State's performance standards combined aspects of the National Public Health Performance Standards with measures used in general health care settings, as well as on-site assessment.<sup>14</sup> Another difference was that this study assessed the *best example* of what sites had to offer and often from just one program. It therefore cannot be assumed that the LPHAs have the staff and resources to replicate their "best examples" in other areas of activity.

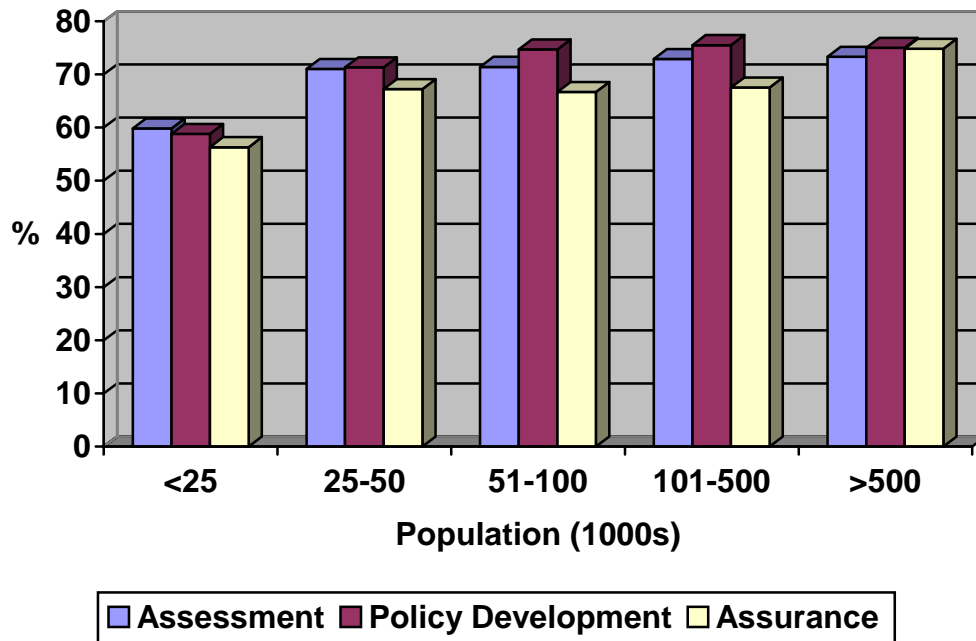
The assessment observed that LPHAs with a budget of \$7 million or more and/or 70 or more FTEs consistently demonstrated higher performance. Nevertheless, there was also a group of smaller LPHAs demonstrating performance on more than 60% of the measures with budgets in the range of \$2 million and less than 30 FTEs. The field observations suggest that smaller LPHAs "can perform at higher levels due to local priority setting; leadership; local funding; staff skill training and experience; and documentation and data systems."

This study is limited by a focus on "best examples" versus overall performance. The report also did not publish the performance analysis data or scatter plots that were described in the text.

## National – 2000-2002

Updating earlier studies, a survey of 2,000 LPHAs in 47 States, District of Columbia and 3 U.S. territories was conducted in 2000-2002.<sup>15</sup> A 20-item questionnaire based on 3 high-level functions was used to self-assess performance. Mean scores tended to improve with increasing population size (Figure 3).

**Figure 3: LPHA Performance by Population Size, U.S., 2000-2002**



Source: Suen and Magruder, 2004.<sup>15</sup>

## Analysis

The preceding overview indicates that a number of investigators in the U.S. have attempted to identify the organizational characteristics that are associated with higher LPHA performance. As noted in a commentary by Bialek, we are not yet at a point of being able to provide an evidence-based response to the request to define the ideal LPHA.<sup>16</sup> Measures of organizational characteristics have been crude and only in recent studies has the assessment of performance become more comprehensive. Reliance on self-reporting raises concerns regarding the validity of responses, as well as the reliability among different LPHAs.

Keeping these potential limitations in mind, a common theme from the studies has been the association of larger population bases with better performance. The major gap in the current literature is the lack of attention to intermediate variables that are presumably

being influenced by the size of the population base. A greater population base will, at a given level of per capita funding, provide the LPHA with a larger staff complement. This provides the opportunity for greater specialization of some positions that could influence the quality and effectiveness of organizational practices and programs. Unfortunately, the literature to-date is not yet mature enough to shed direct light on whether a specific threshold of organizational size, staff complement or associated population base is required to ensure performance.

## Characterizing the Dimensions of “Critical Mass”

The interest in critical mass is based on its association with performance. The relationship flows both ways. A particular level of critical mass will enable a resulting level of performance. Similarly, a desired level of performance will require a particular level of critical mass. According to Turnock and Handler, performance is dependent on infrastructure, program-specific resources, and organizational practices.<sup>17</sup> Each of these inter-related components will be briefly described in the following sub-sections.

### *System Infrastructure*

Infrastructure is the underlying foundation that supports the fulfillment of the system’s functions. The Naylor Report provides a preliminary description of the infrastructure required for the public health system. A subsequent report by a task force of the F/P/T Advisory Committee on Population Health and Health Security (ACPHHS) has addressed in more detail the key components of system infrastructure, which are listed in Table 4.<sup>18</sup> These items are identified for the system as a whole and therefore are not specific to the local system level of LPHAs. The other limitation is that it is not defined how much of these items needs to be in place.

**Table 4: Categories and Elements of Public Health System Infrastructure**

<b>Sufficient and Competent Workforce</b>	<b>Organizational Capacity</b>	<b>Information and Knowledge Systems</b>
<ul style="list-style-type: none"> <li>• Human Resource Planning</li> <li>• Training and Career Development</li> <li>• Human Resource Capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Legislation</li> <li>• System Governance</li> <li>• Leadership</li> <li>• Communication</li> <li>• Defined Functions, Programs and Services</li> <li>• System Development and Structural Capacity</li> <li>• Collaboration and Strategic Decision-making</li> <li>• System Expenditures</li> </ul>	<ul style="list-style-type: none"> <li>• Research and Evaluation</li> <li>• Knowledge Management and Translation</li> <li>• Information Infrastructure</li> <li>• Business Processes</li> </ul>

## ***Program Capacity***

The concept of program capacity includes the various responsibility centres required in a LPHA. These include the actual program teams, but also the many additional specialized and support services.<sup>i</sup> Table 5 provides a listing of these various elements. Again, the limitation is that this list does not indicate how much of these items are required.

**Table 5: Program-Related Capacity**

<b>Program Teams</b>	<b>Specialized Services</b>	<b>Support Services</b>	<b>Management</b>
<ul style="list-style-type: none"> <li>• Chronic diseases</li> <li>• Injuries</li> <li>• Communicable diseases</li> <li>• Environmental health</li> <li>• Healthy development</li> </ul>	<ul style="list-style-type: none"> <li>• Epidemiology</li> <li>• Research and evaluation</li> <li>• Assessment/Planning</li> <li>• Data analysts</li> <li>• Library services</li> <li>• Physician specialists (MOHs)</li> <li>• Emergency preparedness</li> </ul>	<ul style="list-style-type: none"> <li>• Finance</li> <li>• Human resources</li> <li>• Legal</li> <li>• Information technology</li> <li>• Media relations</li> </ul>	<ul style="list-style-type: none"> <li>• CEO</li> <li>• Managers</li> <li>• Clerical and admin support</li> </ul>

## ***Organizational Practices***

Organizational practices reflect how the program-related capacity and other organizational infrastructure work together to fulfill functions and services. Such practices include prioritization, planning, program implementation, monitoring and evaluation, knowledge transfer, continuous quality improvement, and others. Quantifiable information on requirements for these items is not available.

## ***Performance***

Ultimately, the argument for critical mass is one based on performance. In order to achieve functionality “x”, capacity “y” needs to be in place. The challenge is that performance expectations of public health systems in Canada have not been explicitly defined. However, some items may be informative:

- MHPSTG: these are Ontario-specific and define the service delivery expectations for PHUs
- NPHPS (U.S.): these standards are performance-oriented providing a higher level and more detailed set of expectations for LPHAs than the MHPSTGs

<sup>i</sup> It is recognized that there are many ways to structure the program teams but for simplicity, this list is chosen because it mirrors the current MHPSTGs.

- Explicit expectations: it may be useful to define key expectations for LPHAs (e.g. magnitude of outbreak expect to manage before requiring mutual aid from other LPHAs) to clarify the level of expected capacity.

The next section will further explore the potential application of these options.

## **Assessing Expectations for PHU Performance**

### ***Mandatory Health Programs and Services Guidelines***

The MHPSGs define the outputs expected of Ontario LPHAs. Self-assessed compliance through the MPIQ suggests that on average, there is compliance with the majority of requirements. In fact, the MPIQ scores would suggest that there is little wrong with public health in Ontario with average compliance in 2002 of 84% and a range of 72-97%. There are however, several reasons to doubt that these scores are an accurate measure of PHU performance:

- MHPSGs are focussed on service outputs not performance. The Guidelines and associated MPIQ were never designed as a performance assessment tool
- Despite the relatively high scores,
  - the system has been characterized as “broken” by Justice Campbell
  - substantial mutual aid required to address the rubella outbreak in 2005
  - the need to amalgamate Muskoka-Parry Sound Health Unit (and was not the lowest scoring unit in the province).

Examination of individual MPIQ items for assessing performance did not provide any additional useful information. Some PHU activities such as food safety inspections are captured through separate mechanisms and may provide performance related information for this activity.

Another option is to use the MHPSGs to derive the required critical mass for PHUs. For example, one could look at the requirements for a particular program and then estimate the FTEs and other resources that are required. This approach has been previously assessed. At the time of considering revising/expanding several MHPSG programs in 2000/01, the MOHLTC asked the Community Health Research Unit to assess the costing of the MHPSGs. It was determined that it was not possible to attribute required staff and program costs to the MHPSGs because of non-specific wording, and a lack of guidance on reach and intensity.<sup>19</sup> Recommendations to the MOHLTC at the time argued for a rewriting of the MHPSGs in a more standardized fashion that would be useful for a number of purposes including costing and accountability.

## ***U.S. Performance Standards***

The NPHPS has similarities to the MHPSG, but tends to focus more proximally on strategic processes rather than on service outputs. Appendix A provides a list of the essential services and component indicators. Each of these indicators contain a defined explanatory standard and multiple questions to assess performance. For example, indicator 1.1 focuses on the development and use of community health profiles through a series of more than 20 questions. Since such profiles identify needs which will then be used to set local priorities, they are critically important to local public health practice. In contrast, the MHPSG addresses this concept only briefly in the general standards section, which are not included in the MPIQ. The greater depth of the NPHPS questions provide a richer data source and probe the issue of quality versus whether or not something occurred.

One of the potential limitations of the NPHPS is that the indicators apply to the entire local system, not just the LPHA. However, in reviewing the indicators, most appear highly relevant for an Ontario PHU. The indicators viewed collectively, provide an overall impression of a relatively robust organization that has in addition to output capacity, substantial assessment, surveillance, policy, and partnership capacity as well. Undefined is what specifically should be in place to ensure these standards are fulfilled. Presumably, more information will become available in upcoming years as they become more widely used. At this point, the NPHPS can be used to conceptually define selected expectations for Ontario PHUs and their potential impact on critical mass.

## ***Expectations***

The other approach to performance previously suggested was the use of explicit expectations. It is probably here that more concrete critical mass issues will emerge. It is acknowledged at the outset that the level of expectation and associated implications are potentially debatable. In the absence of direct performance-related evidence, it is primarily a policy analysis exercise to attempt to define what is a reasonable level of critical mass to be achieved. This section will outline some selected examples of expectations for PHUs and their potential implication on critical mass. Readers can then judge for themselves if the expectations are reasonable or not.

**Expectation: Each PHU is able to conduct a periodic (e.g. 5 years) comprehensive community health profile with annual updates.**

A PHU cannot effectively address local needs if it cannot comprehensively assess them and apply the information to strategic and program planning.

In addition to the development of community health profiles, there are a number of scenarios in which PHUs will want/need to analyze and interpret local data in a timely fashion:



- Working with community partners and need to generate local relevant data
- In response to a local issue/event
- Support individual programming/planning
- Analyzing own surveillance data and other trends
- Research and evaluation initiatives

This has implications for in-house:

- epidemiology
- research/evaluation
- planner
- analyst
- IT

**Expectation: Each PHU is able to plan, train and exercise for public health emergencies.**

Based on NPHPS:

- Reviewed/revise plan every two years
- Tested plan through simulation or mock event annually
- Ongoing planning and training

This has implications for in-house:

- Dedicated staff to take the lead and be accountable to senior management for this file.

**Expectation: Each PHU is able to identify, investigate and manage public health emergencies**

Most obvious example is communicable disease outbreaks. The issue is what size of outbreak/emergency should a PHU be able to handle on their own without needing significant outside assistance?

Some considerations:

- CEO (MOH under current legislation) needs to manage the overall organizational response and should not have to manage the outbreak investigation as well
- Ideally, AMOH takes lead to manage the outbreak (i.e. heads the outbreak investigation team)
- Field epidemiologist, if available, supplemented to team from province/PHAC
- In-house investigation staff required – primarily CD PHNs and PHIs
- In-house epidemiology support (analysis, mapping, instrument development)
- Risk communications expertise

The following table provides a spectrum of outbreak sizes and complexity with suggested balance of PHU capacity and requirements for external assistance.

<b>Outbreak Scenario</b>	<b>PHU</b>	<b>Mutual Aid Required</b>
2 deaths of teenagers due to meningococcal disease – decision to mass immunize	Coordinate mass immunization; hire additional inoculators; manage media; have epi analysis capacity	Minimal – although will have involved province in decision-making; budget assistance; additional inoculators may come from acute care (LHIN) or other public health units if required
Large school-based outbreak of rubella	Conduct investigation, manage media; coordinate immunization clinics as required; have epi analysis capacity	Some – may need additional investigation staff if caseload particularly high; budget assistance
Community water supply outbreak of gastrointestinal disease	Conduct investigation, manage media; have epi analysis capacity	Some – may need additional investigation staff; field epi likely helpful; budget assistance
Community-wide outbreak of novel or serious pathogen	Conduct investigation, manage media; have epi analysis capacity	Substantial – likely need additional investigation/control staff, field epi, additional epi, “B” team thinkers; specialized expertise; budget assistance

The underlying assumption to the above table is that there is capacity within each PHU to initially respond to a public health emergency. As the emergency scenario grows in magnitude, there is a greater need for mutual aid (scalability) and specialized assistance. However, it assumes that the PHU has an existing infrastructure/capacity to investigate and manage that can be supplemented if necessary, versus a scenario where there is little intrinsic capacity.

This has implications for in-house:

- Public health physician specialists (one of which is distinct from CEO)
- Epidemiology
- Analyst
- IT capacity and support
- Communications expertise
- Highly competent executive management
- Investigation and control staff including program managers.

**Expectation: Each PHU is able to effectively use the media proactively and in crisis situations**

This involves media relations which needs to be readily accessible to the PHU who can receive calls frequently (i.e. daily) and whose responses have to be very timely and

strategic to the media. It also includes use of social marketing competencies in the appropriate development and implementation of programming.

This has implications for in-house:

- Media relations (might be shared, but needs to be highly responsive, know PHU business and local media environment)
- Social marketing – part of competencies for health promotion specialists

**Expectation: Each PHU is able to engage in local policy analysis and development**

Policy development involves problem identification, knowledge of possible solutions and societal values that join to set a course of action. Expect every PHU to have this capacity.

This has implications for in-house:

- Public health policy expertise

**Expectation: Each PHU is able to engage in strategic planning**

Take findings from community health profile, identify priorities and develop multi-year plan to address needs.

This has implications for in-house:

- Planner
- Epidemiologist
- Executive team with strategic vision, leadership, systems thinking/application

**Expectation: Each PHU is able to enforce laws and regulations**

This has implications for in-house:

- Legal assistance (most likely shared/contracted)
- Ability to support/inform Board of their legislative authority/responsibility
- Sufficient inspection/monitoring/enforcement staff

## ***Implications for Critical Mass***

The above analysis indicates that there are two dimensions to the critical mass issue:

1. Unique skill sets that must be represented – there may only be one, two or a few of these individuals with these skill sets in the organization. Examples include epidemiologist, MOH, data analyst, etc.
2. Program teams – possessing minimum size and complement of skill sets.

### **Medical Officer of Health**

Currently, every PHU requires a full-time MOH. There is no argument that this should not be the case since:

- a. Explicitly required in the HPPA
- b. Required to fulfill the legislative authorities under the HPPA
- c. Highly trained specialists that bring a range of skills and expertise to the spectrum of public health issues

Despite this, and as outlined in recent reviews, there continue to be many PHUs with longstanding vacancies in this position. The implication of such vacancies was made clear in the recent Rubella outbreak in which MOHs (and other public health staff) from other PHUs had to be seconded immediately into the PHU to help control the outbreak.

There are additional arguments for there to be at least two MOHs (i.e. an MOH and an AMOH) within each PHU:

- a. Professional support - avoid isolated practitioner
- b. Mentoring and preparation of more junior specialists to take on eventual broader role of senior position
- c. More reasonable call schedule
- d. Back-up for holidays, vacancies
- e. Contribute specialist expertise to a broader set of programs – widening set of public health issues becoming more difficult for single practitioner to cover
- f. Lead investigator in place (AMOH) for outbreaks.

## **Epidemiologist**

It is assumed that each PHU should have a full-time epidemiologist who has been trained at the Masters or doctorate level.<sup>1</sup> Epidemiology is a basic public health science and there are a multitude of reasons for needing at least one of these individuals in each PHU:

- Population health needs assessment
- Produce issue/program specific data to support planning, evaluation, policy development
- Surveillance functions
- Support research and evaluation (viewed that need separate person for these tasks)
- Support outbreak investigation.

These tasks are all expected to be performed by PHUs on an ongoing basis. These require in-house epidemiologic expertise in addition to that provided by the MOHs. One might argue that expertise like this could be provided across PHUs. The problem with this approach is that an epidemiologist provides skills that should support several programs and needs to be at the table when strategic decisions are being made. A shared model would impair fulfilling this requirement. There would continue to be a regional/provincial role in support of the local epidemiologists (e.g. development of data sources; templates for needs assessments and profiles; skills development (e.g. mapping); data integration, etc.).

## **Other Specialized Positions**

There are many other types of specialized positions that should be considered for inclusion in an organization: (non-exhaustive list)

- Business manager – lead individual on administrative issues; required whether or not some support services are shared
- Data analyst – to ensure optimum use of epidemiologist
- Library science – public health is a knowledge-based practice, need capacity to store and retrieve knowledge
- Research/program evaluation officers – need ability at minimum to assess implementation of programming
- Media relations/communications – PHUs have responsive and pro-active requirements for quality media relations. Also includes ability to perform risk communications.

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<sup>1</sup> The minimal competencies required of public health epidemiologists are currently being developed by APHEO and the Public Health Agency of Canada.

## Program Teams

The bulk of the staff of a PHU will be comprised of program/discipline teams. As per the earlier MHPSG discussion, it is difficult to precisely identify a threshold in the absence of specific performance data. Nevertheless, there are several reasons why a minimum size is reasonable:

- a. Manage vacancies
- b. Mix of skills
- c. Leader development
- d. Surge capacity.

The more challenging question is what is a reasonable size that fulfills these criteria. As previously described, neither the literature nor the MHPSGs are directly informative. To fully address this question, one would need to use a Delphi-like approach involving key stakeholders to identify the core capacity required for each program. One would also need to identify the additional capacity that would need to be scalable to differences in population size, geography, and other unique factors. The scope of such a process is beyond the timelines and capacity of the CRC. Nevertheless, one needs some numbers to be able to perform an initial analysis. Recognizing that any specific numbers will be arbitrary, the following are some initial suggestions. As shown, the minimum number has been chosen considering the above factors as well as being set larger than currently exists in the Oxford County Health Unit (the epicentre for the 2005 rubella outbreak).

<b>Position</b>	<b>Minimum Number</b>	<b>Rationale</b>
Public health inspectors	15	<ul style="list-style-type: none"> <li>• Team size to fulfill a-d above</li> <li>• About 50% more than Oxford County complement</li> </ul>
Public health nurses	30	<ul style="list-style-type: none"> <li>• Team size to fulfill a-d above</li> <li>• About 50% more than Oxford County complement</li> </ul>
Health promoters (nutrition, health educator, health promoter)	5-8	<ul style="list-style-type: none"> <li>• Have on average one per major program team</li> </ul>

It is recognized that a discipline-based focus is overly simplistic considering the multi-disciplinary nature of most teams. However, one needs to start somewhere and most of the PHU staffing data is discipline- and not team-based.

## Application of Critical Mass Concepts to Ontario Context

The existing literature consistently suggests that the population base is associated with LPHA performance. The following tables provide a high-level summary of the current mixture of PHUs. Figure 4 shows that the population bases of PHUs are widely divergent with 15 of 36 PHUs having populations of less than 135,000. Four PHUs have populations of 600,000 or greater.

**Figure 4: Population Distribution of Ontario Public Health Units**

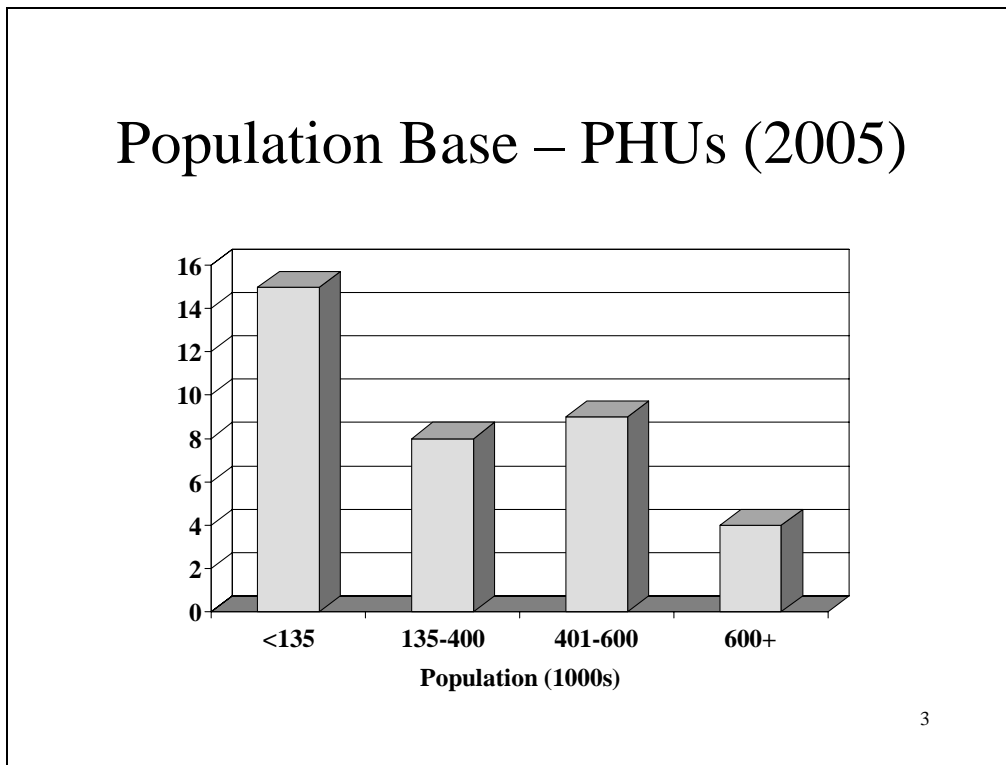
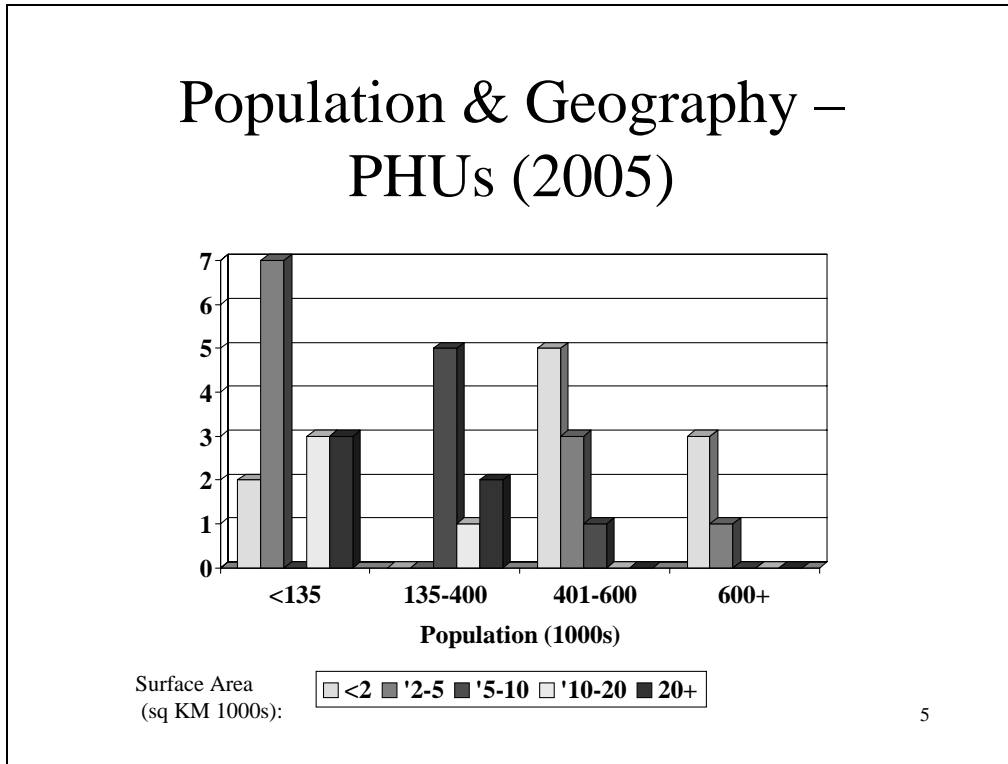


Figure 5 shows that the surface area of PHUs varies considerably from less than 2,000 sq km to more than 20,000 sq km. Smaller population size PHUs come in two distinct forms: a) large geographic size; and b) small geographic size.

**Figure 5: Population and Surface Area of Ontario Public Health Units**





Size of the population base is strongly associated with employment of individuals with specialized skills. Figure 6 shows that 25% of PHUs lack a full-time epidemiologist and that these are over-represented among smaller population PHUs.

**Figure 6: Lack of Full-Time Epidemiologist by Public Health Unit Population**

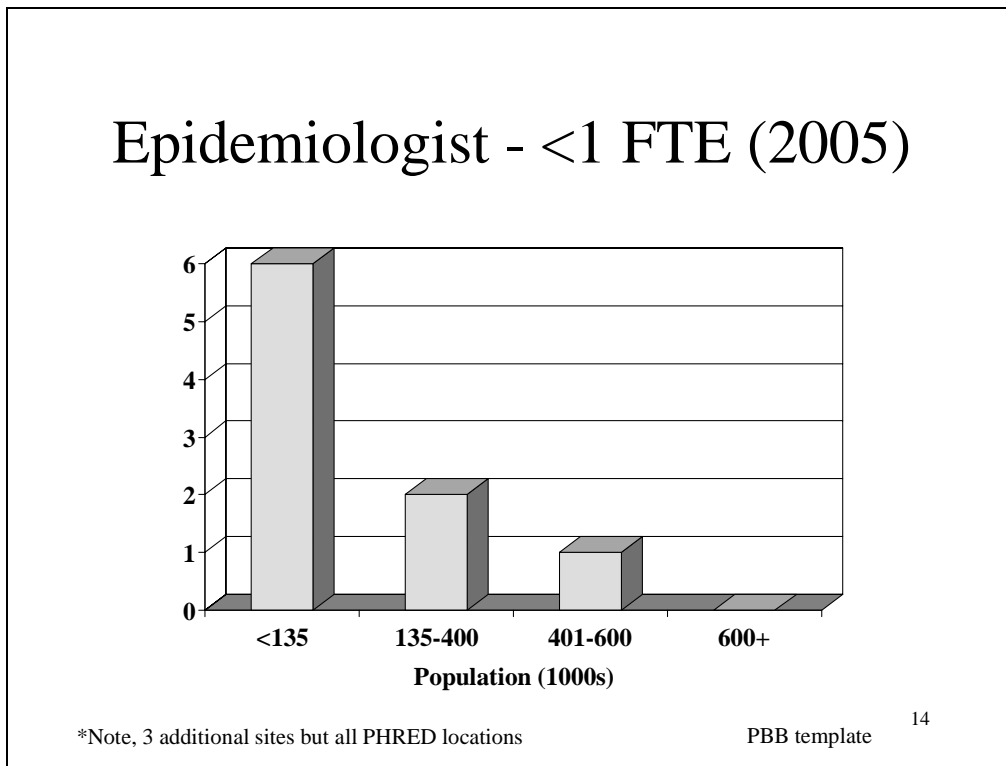


Figure 7 shows the population of PHUs that did not have a full-time, Minister-appointed MOH for at least 5 of the past 10 years. In 2004, 9 of 37 PHUs fulfilled this criteria. As shown in Figure 7, this does not appear to be a chance occurrence since all of the PHUs that have had longstanding MOH vacancies have had populations of less than 135,000.

To characterize this phenomenon in terms of risk, if one arbitrarily sets the population threshold at 125,000, then a low population PHU is 37 times more likely to have a longstanding vacancy compared with larger population PHUs. This phenomenon is not more common in the North where half of small population health units have longstanding vacancies, while this occurred in 7 of 12 in the South of the province (primarily southwestern Ontario).

**Figure 7: Longstanding MOH Vacancies, 2004**

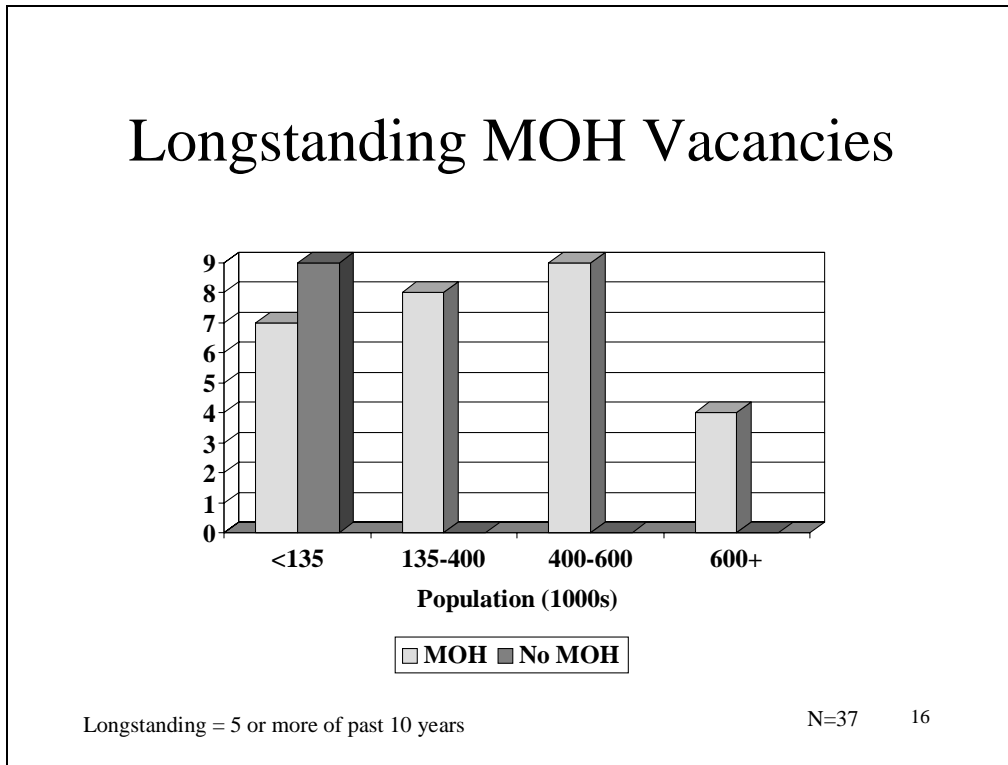
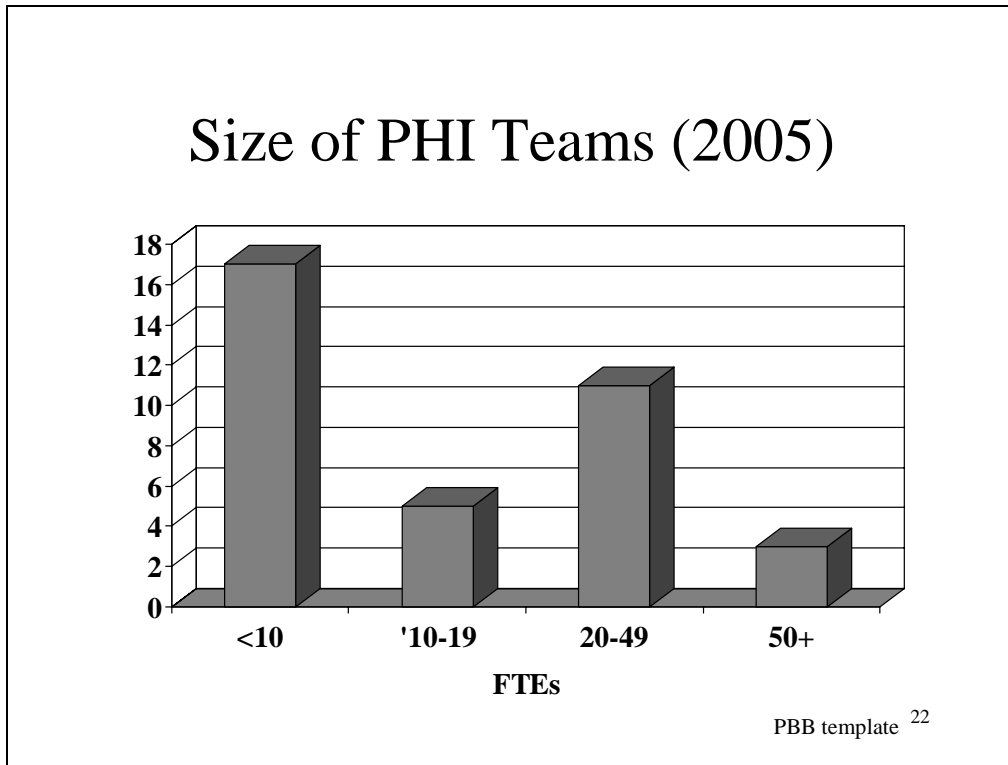


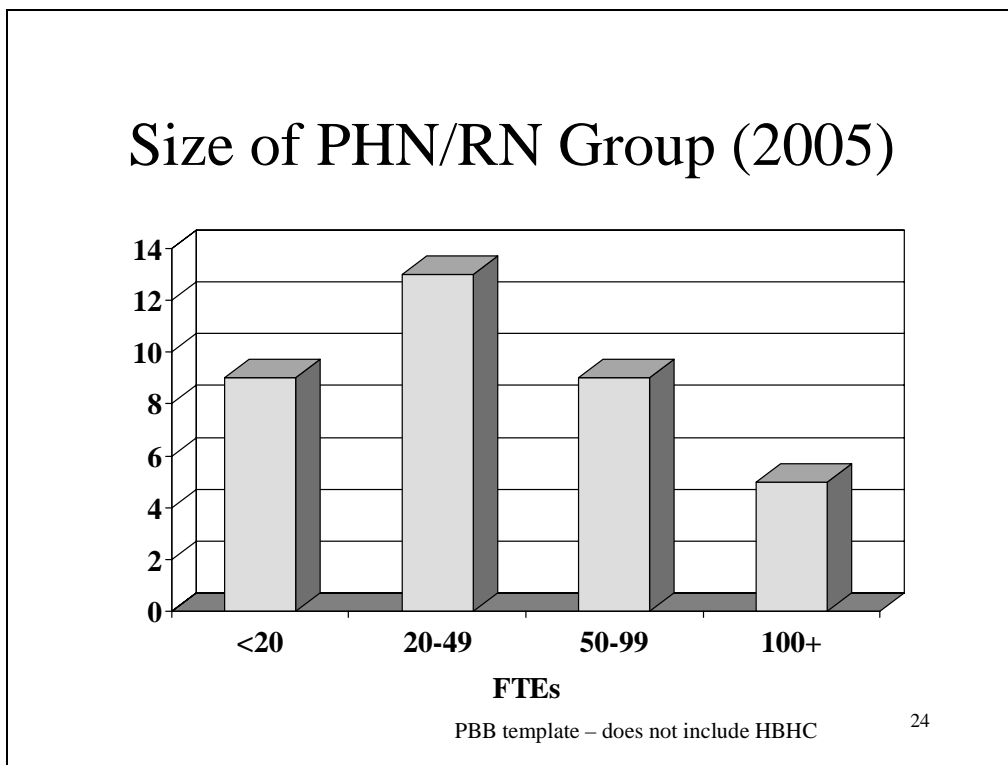
Figure 8 shows the distribution of public health inspector (PHI) full-time equivalents according to the 2005 PBB templates that are completed as part of the budget process by PHUs. Seventeen PHUs have PHI staff complements of less than 10 inspectors (not including WestNile funded positions). If the threshold is set at 15 FTEs, then 20 PHUs have less than this complement of staff.

Figure 9 shows the distribution of public health nurse (PHN) full-time equivalents according to the 2005 PBB templates. Nine PHUs have PHN staff complements of less than 20 PHNs (not including Healthy Babies, Healthy Children funded positions). If the threshold is set at 30 FTEs, then 11 PHUs have less than this complement of staff.

**Figure 8: Number of Public Health Inspectors in Ontario Public Health Units**

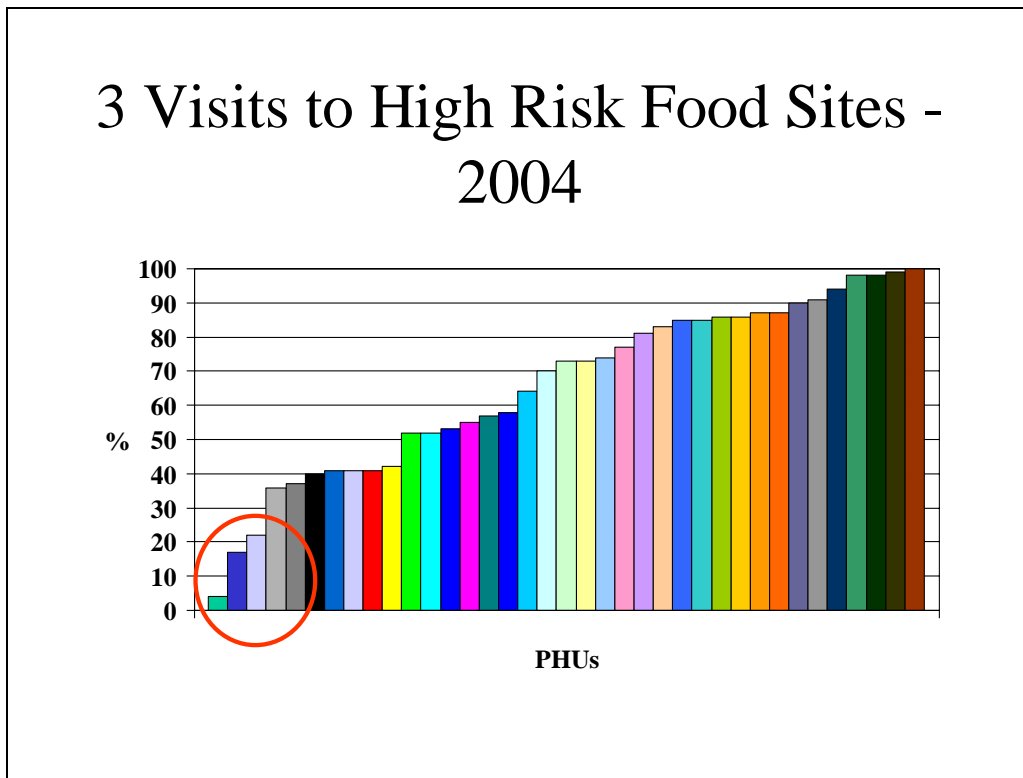


**Figure 9: Number of Public Health Nurses in Ontario Public Health Units**



A previous section noted that food safety inspections are captured outside the MPIQ. Food establishments are categorized as high, medium or low risk by each PHU. High risk establishments are to be inspected at least 3 times a year. Figure 10 shows that the proportion of high risk food establishments that received the required number of visits varied substantially across the province. Three outliers are circled in the figure that had particularly low levels of achievement of this expectation. All three of these PHUs have smaller population bases and longstanding MOH vacancies.

**Figure 10: Proportion of High Risk Food Establishments that Received 3 Inspection Visits - Ontario Public Health Units**



Beyond these three PHUs, no clear association was detected between the number of inspections and population base, PHI/population staffing ratios or a number of other variables. Part of the reason may be that the proportion of food establishments that are self-rated as high is highly variable. In fact, some of the higher performing PHUs in Figure 10 had relatively low proportions of their food establishments self-rated as high-risk. Other complexities also exist within this data including the nature/intensity of the inspection visit and the extent of follow-up of establishments with concerns noted on routine inspections. Nevertheless, it is intriguing that the lowest performing PHUs have characteristics consistent with the findings of other key critical mass characteristics.

If one were to begin to develop an initial critical mass model, it might look like the following:

Disciplines with Small Numbers	Teams
<ul style="list-style-type: none"> <li>• MOHs (2)</li> <li>• Epidemiologist</li> <li>• Business manager</li> <li>• Emergency preparedness coordinator</li> <li>• Library service</li> <li>• Assessment/surveillance/research/evaluation:               <ul style="list-style-type: none"> <li>• Research/evaluation</li> <li>• Data Analyst</li> <li>• Planner</li> </ul> </li> <li>• Media/communications</li> </ul>	<ul style="list-style-type: none"> <li>• Program teams:               <ul style="list-style-type: none"> <li>• CD, injury, env'tal health, chronic disease, healthy development</li> <li>• Discipline</li> <li>• Staff and managers</li> <li>• Admin support</li> </ul> </li> <li>• Support services (HR, IT, finance, legal)</li> </ul>

While the above table gives some indication of critical mass, particularly for unique skill sets, it does not provide a full characterization of the minimum design specifications for programmatic teams that comprise the bulk of the staff. Nevertheless, it may provide sufficient information to guide decision-making regarding configuration of existing PHUs.

## Discussion

The concept of critical mass is firmly established in the public health system infrastructure literature, but not yet well characterized. The existing literature indicates that larger LPHAs as measured by FTEs, budget, and population served, perform on average, better than smaller PHUs. Unfortunately, the literature is not yet sufficiently advanced to describe the minimum design specifications for LPHAs. This should not be a surprise considering the lack of attention to public health system services research in general. With the evolution and application of performance standards across the U.S., hopefully greater insights can be obtained. Ideally, greater attention to public health services research in Canada would contribute to this body of knowledge.

Despite the limitations of existing research in this area, assessment of specific aspects of critical mass in Ontario showed strong associations with the population base of PHUs:

- Longstanding MOH vacancies: all PHUs that have not had an MOH for 5 or more of the past 10 years have had populations of less than 135,000
- The lack of a full-time epidemiologist is much more common among smaller population PHUs
- Small population PHUs can have extremely small complements of PHIs and PHNs
- PHU outliers for low achievement of high risk food establishment inspections have small population bases and absence of a full-time Minister appointed MOH.

These findings confirm the perceptions of earlier Ontario reports that critical mass is an issue in Ontario PHUs. Further analysis is required to assess options to address this issue. Previous reports have suggested that consolidation of some existing PHUs is a potential mechanism to achieve critical mass, but geographic and other factors will need to be taken into consideration. Another option is to simply fund increased capacity of existing PHUs. This of course requires additional permanent resources. This would also require increasing per capita expenditures in smaller PHUs which in many cases are already higher than larger PHUs.

There are also additional feasibility and efficiency issues that must be considered. While one might decide to fund individual PHUs to a higher extent, this does not mean that they will be able to recruit and retain specialized staff who are typically in short supply. There are additional system issues regarding the ability to coordinate and ensure quality in “x” number of PHUs across the province. Alignment of PHUs with other entities such as municipalities and LHINs also need to be considered. In short, critical mass is important, but cannot be the only criterion that is considered in configuring the local level of the public health system in Ontario. The next step is to begin to apply critical mass factors identified in this paper to specific Ontario PHUs.

## Appendix A – Local Public Health System Performance Standards (U.S. CDC)

The National Public Health Performance Standards for Local Public Health Systems<sup>20</sup> include the following indicators:

<b>Public Health Essential Service</b>	<b>Indicator</b>
Monitor Health Status to Identify Community Health Problems	<ul style="list-style-type: none"> <li>• Population-based community health profile</li> <li>• Access to and utilization of current technology to manage, display, analyze and communicate population health data</li> <li>• Maintenance of population health registries</li> </ul>
Diagnose and Investigate Health Problems and Health Hazards in the Community	<ul style="list-style-type: none"> <li>• Identification and surveillance of health threats</li> <li>• Plan for public health emergencies</li> <li>• Investigate and respond to public health emergencies</li> <li>• Laboratory support for investigation of health threats</li> </ul>
Inform, Educate, and Empower People about Health Issues	<ul style="list-style-type: none"> <li>• Health education</li> <li>• Health promotion activities to facilitate healthy living in healthy communities</li> </ul>
Mobilize Community Partnerships to Identify and Solve Health Problems	<ul style="list-style-type: none"> <li>• Constituency development</li> <li>• Community partnerships</li> </ul>
Develop Policies and Plans that Support Individual and Community Health Efforts	<ul style="list-style-type: none"> <li>• Governmental presence at the local level</li> <li>• Public health policy development</li> <li>• Community health improvement process</li> <li>• Strategic planning and alignment with the community health improvement process</li> </ul>
Enforce Laws and Regulations that Protect Health and Ensure Safety	<ul style="list-style-type: none"> <li>• Review and evaluate laws, regulations and ordinances</li> <li>• Involvement in the improvement of laws, regulations and ordinances</li> <li>• Enforce laws, regulations and ordinances</li> </ul>
Link People to Needed Personal Health Services and Assure the Provision of Health Care when Otherwise Unavailable	<ul style="list-style-type: none"> <li>• Identification of populations with barriers to personal health services</li> <li>• Identifying personal health services needs of populations</li> <li>• Assuring the linkage of people to personal health services</li> </ul>

<b>Public Health Essential Service</b>	<b>Indicator</b>
Assure a Competent Public and Personal Health Care Workforce	<ul style="list-style-type: none"> <li>• Workforce assessment</li> <li>• Public health workforce standards</li> <li>• Life-long learning through continuing education, training, and mentoring</li> <li>• Public health leadership development</li> </ul>
Evaluate Effectiveness, Accessibility, and Quality of Personal and Population-Based Health Services	<ul style="list-style-type: none"> <li>• Evaluation of population-based health services</li> <li>• Evaluation of personal health services</li> <li>• Evaluation of local public health system</li> </ul>
Research for New Insights and Innovative Solutions to Health Problems	<ul style="list-style-type: none"> <li>• Fostering innovation</li> <li>• Linkage with institutions of higher learning and/or research</li> <li>• Capacity to initiate or participate in timely epidemiological, health policy, and health systems research</li> </ul>



## References

- (1) Frank J, DiRuggiero E, Moloughney B. The future of public health in Canada: developing a public health system for the 21st century. Toronto: CIHR, 2003.
- (2) National Advisory Committee on SARS and Public Health. Learning from SARS: renewal of public health in Canada. Ottawa: Health Canada, 2003.
- (3) Cognitive Science Laboratory, Princeton University. WordNet. 2005. Available from: <http://wordnet.princeton.edu/>. Accessed: 11-8-2005.
- (4) Institute of Medicine. The future of public health. Washington: National Academy Press, 1988.
- (5) Turnock BJ, Handler A, Hall W, Potsic S, Nalluri R, Vaughn EH. Local health department effectiveness in addressing the core functions of public health. Public Health Rep 1994; 109(5):653-658.
- (6) Handler AS, Turnock BJ. Local health department effectiveness in addressing the core functions of public health: essential ingredients. J Public Health Policy 1996; 17(4):460-483.
- (7) Suen J, Christenson GM, Cooper A, Taylor M. Analysis of the current status of public health practice in local health departments. Am J Prev Med 1995; 11(6 Suppl):51-54.
- (8) Richards TB, Rogers JJ, Christenson GM, Miller CA, Taylor MS, Cooper AD. Evaluating local public health performance at a community level on a statewide basis. J Public Health Manag Pract 1995; 1(4):70-83.
- (9) Mays GP, Halverson PK, Baker EL, Stevens R, Vann JJ. Availability and perceived effectiveness of public health activities in the nation's most populous communities. Am J Public Health 2004; 94(6):1019-1026.
- (10) Freund CG, Liu Z. Local health department capacity and performance in New Jersey. J Public Health Manag Pract 2000; 6(5):42-50.
- (11) Zahner SJ, Vandermause R. Local health department performance: compliance with state statutes and rules. J Public Health Manag Pract 2003; 9(1):25-34.
- (12) Kennedy VC. A study of local public health system performance in Texas. J Public Health Manag Pract 2003; 9(3):183-187.
- (13) Scutchfield FD, Knight EA, Kelly AV, Bhandari MW, Vasilescu IP. Local public health agency capacity and its relationship to public health system performance. J Public Health Manag Pract 2004; 10(3):204-215.

- (14) Mauer BJ, Mason M, Brown B. Application of quality measurement and performance standards to public health systems: Washington State's approach. *J Public Health Manag Pract* 2004; 10(4):330-337.
- (15) Suen J, Magruder C. National profile: overview of capabilities and core functions of local public health jurisdictions in 47 states, the District of Columbia, and 3 U.S. territories, 2000-2002. *J Public Health Manag Pract* 2004; 10(1):2-12.
- (16) Bialek R. Building the science base for public health practice. *J Public Health Manag Pract* 2000; 6(5):51-58.
- (17) Turnock BJ, Handler AS. Performance measurement and improvement. In: Novick LF, Mays GP, editors. *Public health administration: principles for population-based management*. Gaithersburg, Maryland: Aspen Publishers Inc., 2001.
- (18) Advisory Committee on Population Health and Health Security. *Improving public health system infrastructure in Canada: report of the Strengthening Public Health System Infrastructure Task Group*. Ottawa: Public Health Agency of Canada, 2005.
- (19) Dunkley G, Edwards N, Moloughney B, Spasoff R. *Assessing the resource implications of revisions to the Mandatory Health Programs and Services Guidelines. Interim report*. Ottawa: Community Health Research Unit, 2001.
- (20) Centers for Disease Control and Prevention. *National public health performance standards program: local public health governance performance assessment*. Atlanta: CDC, 2003.