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Issue Brief:
Measuring Health System Efficiency in Canada

7 November 2011

McMaster Health Forum

For concerned citizens and influential thinkers and doers, the McMaster Health Forum strives to be a leading hub for improving health outcomes through collective problem solving. Operating at the regional/provincial level and at national levels, the Forum harnesses information, convenes stakeholders, and prepares action-oriented leaders to meet pressing health issues creatively. The Forum acts as an agent of change by empowering stakeholders to set agendas, take well-considered actions, and communicate the rationale for actions effectively.

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Measuring Health System Efficiency

KEY MESSAGES

What's the issue?

- Many challenges are encountered in health system efficiency measurement, with key ones including:
 - There is no consensus on how to define the objective of the health system, and choices of objective and output measure appear to be made primarily on the basis of data availability and comparability.
 - There also appears to be no consensus about how to define the inputs to the health system (e.g., number of physicians) and environmental constraints that can influence the efficiency of the health system (e.g., education level).
 - While health system analysts in Canada have access to data that are comparable to those used in previous studies, the lack of availability of much of these data at the regional level is a significant impediment to measuring health system efficiency in the country.
 - There is also a lack of consensus about the methodological approach that should be taken to measure inputs and outputs and to relate them to one another.

What do we know about three elements of a model of health system efficiency?

- Element 1 – Establish a clear objective for the health system
 - Maximizing average population health (using disability-adjusted life expectancy as the output measure) gives attention to both mortality and disability, however, it also attributes all mortality and disability to a failure of the health system, and it assumes that individuals establish their expectations for the health system before they are diagnosed with a condition.
 - Enhancing system performance (using potential years of life lost as the output measure) can be focused on diagnoses specifically amenable to healthcare, accommodates individuals who establish their expectations for the health system after diagnosis, and is mentioned frequently in interviews with civil servants, but it focuses on mortality only and not on mortality and disability.
 - Reducing inequalities, which can be combined with either of the other two objectives, is mentioned infrequently in government documents as a health system objective, and it requires a trade-off between maximizing health and reducing inequalities if sicker or poorer individuals have a lower capacity to benefit from healthcare, or they use more resources for the same level of need.
- Element 2 – Establish clear boundaries for the health system
 - Inputs available to the system (i.e., factors within the control of health system decision-makers) typically include either or both of: 1) countable capital (e.g., hospitals) and labour (e.g., physicians) inputs to the system, which helps to answer questions about technical efficiency; and 2) healthcare expenditures (i.e., dollars spent), which helps to answer questions about cost efficiency.
 - Environmental constraints under which the system must work (i.e., factors outside the control of health system decision-makers) typically include 'non-controllable' characteristics of citizens being served (e.g., education level), characteristics of the external environment (e.g., income inequality), activities in other related agencies (e.g., housing organizations), previous organizational efforts in disease prevention and health promotion, and the quality of resources being used.
- Element 3 – Select appropriate methods and collect appropriate data for measuring efficiency
 - Of the two approaches to estimating an optimal level of performance, one requires no strong assumption about the nature of the relationship between inputs and outputs, but the second isn't as sensitive to extreme cases and is better able to separate false from true inefficiencies.
 - Most key gaps in the data needed to measure health system efficiency are at the health region level.

What are the potential uses of a measure of health system efficiency and how can they be supported?

- A number of the barriers to developing and using a measure of health system efficiency could be addressed by: 1) an iterative process of experimenting with particular choices of health system objective, inputs, environmental constraints and methods; and 2) a robust communications plan focused on communicating key messages clearly and preparing key health system leaders prior to their release.

Measuring Health System Efficiency

REPORT

This issue brief addresses the issue of how we should measure health system efficiency in Canada. The issue brief (and the stakeholder dialogue it was prepared to inform) was designed to feed into a report and analysis framework on health system efficiency by the Canadian Institute for Health Information, which is an organization uniquely positioned (by virtue of the national provincial/territorial and regional data it manages and its in-house analytical capacity) to measure health system efficiency in Canada (Box 1).

Two features of the broader health policy and system context in Canada are important to bear in mind when discussing health system efficiency measurement:

- the Canadian healthcare system is comprised of 13 publicly financed healthcare systems (10 provincial and three territorial); and
- each province has devolved decisions relating to the planning, funding and integration of healthcare to regional health authorities, and the number of regional health authorities and the types of decisions that each are allowed to make vary by province (although some provinces, such as Alberta and Prince Edward Island, have ‘re-centralized’ decision-making).

Lack of a model of health system efficiency in Canada

Many reports have been published about the inputs to and outputs of the Canadian health system at federal, provincial/territorial and regional levels. Moreover, Canada has been included in cross-national studies that measure health system efficiency, including what is arguably the best known such study, which was published by the World Health Organization (WHO) in 2000 (and is called in this issue brief the WHO 2000 report).⁽²⁾ However, no studies have measured health system efficiency within Canada’s provincial/territorial health systems.

Consequences of not having a model

Without a country-wide study of health system efficiency in Canada, policymakers and independent organizations (e.g., quality councils) cannot publicly report how the system as a whole – the full set of

Box 1: Background to the issue brief

This issue brief mobilizes both global and local research evidence about the issue of health system efficiency measurement in Canada, three elements of a model for measuring health system efficiency, and key implementation considerations (specifically the potential uses of the model and how these uses can be supported). Whenever possible, the issue brief summarizes research evidence drawn from empirical research studies conducted in Canada. The issue brief does not contain recommendations.

The preparation of the issue brief involved five steps:

- 1) convening a Steering Committee comprised of representatives from the partner organization (Canadian Institute for Health Information, hereafter called CIHI) and the McMaster Health Forum;
- 2) developing and refining the terms of reference for an issue brief, particularly the framing of the issue and three key elements of the model, in consultation with the Steering Committee and with the aid of several reports written or commissioned by CIHI, that organize thinking about ways to approach the issue;
- 3) identifying, selecting, appraising and synthesizing relevant research evidence about the issue, model elements and implementation considerations;
- 4) drafting the issue brief in such a way as to present concisely and in accessible language the global and local research evidence; and
- 5) finalizing the issue brief based on the input of several merit reviewers.

Unlike a Forum evidence brief, a Forum issue brief is not informed by key-informant interviews conducted by Forum staff, and does not involve as comprehensive an evidence review by Forum staff. However, one of the CIHI-commissioned reports involved a set of key-informant interviews and other reports involved extensive literature reviews and a documentary analysis.

The issue brief was prepared to inform a stakeholder dialogue at which research evidence is one of many considerations. Participants’ views and experiences and the tacit knowledge they bring to the issues at hand are also important inputs to the dialogue. One goal of the stakeholder dialogue is to spark insights – insights that can only come about when all of those who will be involved in or affected by future decisions about the issue can work through it together. A second goal of the stakeholder dialogue is to inform the wider policy community and scientific community (so that they will be in a position to use, promote or refine a tool to measure health system efficiency) in addition to feeding into a report and analysis framework by CIHI on health system efficiency.

provincial and territorial systems that constitute it – is performing, and hence cannot underpin provincial and territorial systems’ efforts to strengthen public accountability or identify room for improvement in health system performance. Provincial and territorial policymakers also cannot use ‘benchmarkable’ measures to hold health regions accountable or to help regions identify room for improvement.

Key concepts

We identified four concepts that are key to understanding the measurement of health systems efficiency:

- efficiency (technical efficiency): the ratio of quantity of output achieved to the maximum quantity of output achievable, conditional on quantity of input;
- output-oriented efficiency: given the current level of inputs/spending, how can we maximize outputs?;
- cost containment, or input-oriented efficiency: by how much can we reduce costs/inputs while maintaining the same level of ‘output’?; and
- productivity: the ratio of units of output to units of input, or how much output do we get per unit of input?

The Canadian Institute for Health Information is interested in measuring output-oriented efficiency: how can we maximize what the health system produces for a given level of resources?

THE ISSUE

The challenges posed by health system efficiency measurement include: 1) conflicting views about the objective of the health system (i.e., what do we produce with the resources we put into the system); 2) conflicting views about and cross-provincial variation in the boundaries of the system (i.e., what are the inputs within the control of health system decision-makers, and what are the environmental constraints beyond the control of these decision-makers); and 3) methodological disagreements about and data challenges in health system efficiency measurement. We address each of these challenges in turn below.

Conflicting views about the objective of the health system

From the review of the empirical literature (Box 2), including studies by the Organization for Economic Cooperation and Development and WHO and in the broader academic literature, there is no consensus on how to define the objective(s) of the health system. The authors of empirical studies tend not to provide a rationale for choosing objective(s) or output measure(s). Their choices appear to be made primarily on the basis of data availability and comparability. For example, one author noted that morbidity- or disability-adjusted longevity indicators are better indicators of the population’s health, but that they aren’t available.⁽³⁾ Hence the author chose life expectancy at birth because it is available for many countries and, at the same time, shows high correlation with morbidity- and disability-adjusted longevity indicators.⁽³⁾

Box 2: Mobilizing research evidence about the issue

The available research evidence about the issue was sought by staff of the Canadian Institute for Health Information from a range of published and “grey” research literature sources. The sources included:

- a search of Medline and EconLit, using the following search terms: (“health care system” OR “health system”) AND (“productivity” OR “efficiency”), as well as the following limits: 1995-current and English language (n=138);
- a review of the studies included in a systematic review conducted in 2006 on the same topic (n=94);⁽¹⁾ and
- a review of key documents, including grey literature (n=58).

From this collection of 290 articles and reports, 117 did not meet the inclusion criteria while 173 did. The latter were divided into three groups:

- efficiency measurement, meaning those that measure technical efficiency of several health systems (n=56, of which one also fits under input/output);
- input/output, meaning those that discuss options for measuring inputs and outputs of health systems (n=28); and
- methods and other issues (n=90).

Key messages were synthesized from each group of articles and reports.

A health system-level analysis can be performed at any level above an individual organization, such as a hospital, and with a wide variety of output measures. Of the 56 health system-level analyses that were identified (as opposed to the sectoral studies, such as those conducted in the hospital sector), 31 were conducted at the country level, seven at the sub-national level, and 17 at the local level. The perspective adopted in these analyses may vary from that of a primary care purchasing organization to that of a ministry of health acting as a public payer and steward for both public and private components of the system. In the same pool of 56 health system-level analyses:

- 41 studies used average population health as a measure of output, with 16 studies using the infant mortality rate as one of their measures,(4) 19 using life expectancy,(5) and 13 using disability-adjusted life expectancy or similar measures(2) (the numbers do not add to 41 because an analysis could use more than one measure of average population health);
- 12 studies used activity as a measure of output (e.g., numbers of visits or hospital stays);(6) and
- three studies used neither average health nor activity as measures of output.

The nine studies that contested certain aspects of the methodology used by prior studies, such as the WHO 2000 report,(2) all used average population health as measure of output.

A simple regression analysis using data drawn from 40 analyses – unit of analysis, type of input and output measures used, method used, and year and type of publication – found a significant correlation between unit of analysis and type of output measure. Most of the studies that used country as the unit of analysis (15 papers) also used average health of the population as the measure of output.

Conflicting views about and cross-provincial variation in the boundaries of the system

There also appears to be no consensus about how to define the inputs to the health system (e.g., number of physicians) and the environmental constraints that can influence the efficiency of the health system (e.g., educational level). These choices again appear to be made primarily on the basis of data availability and comparability. For example, one author suggested that a particular choice of inputs facilitated cross-country comparisons,(7) while another author argued that a given choice of input variables was based on completeness and consistency of data reported across countries.(8)

In the 56 health system-level analyses, the following input measures were chosen:

- 19 studies used physical resources as inputs, with the number of inpatient beds, physicians and nurses among the most frequently chosen measures;
- 13 studies used monetary units, such as the dollar value of resources used in the system, as inputs;(2)
- 14 studies used both physical resources and monetary units (e.g., the number of general practitioners and nurses and the gross expenditure on general medical services);(9) and
- nine studies used education (including the WHO 2000 report and the eight studies that replicate its methodology).

The numbers do not add to 56 because an analysis could use more than one input measure.

Many studies acknowledged the existence of environmental constraints that influence the efficiency of health systems. However, there is no consistency in the choice of these parameters. In about one third of the 56 empirical studies, analyses were performed in two steps:

- 1) calculate efficiency/inefficiency scores; and
- 2) run a regression analysis to find associations between selected parameters and efficiency/inefficiency scores.

Data challenges in and methodological disagreements about health system efficiency measurement

In Canada, health system analysts have access to data that are comparable to those used in previous studies (e.g., healthcare expenditures and the numbers of doctors, nurses and hospital beds as input measures, and average population health indices and numbers of hospital stays as output measures). However, the main shortcoming with the available Canadian data compared to other studies is its lack of availability by region. For example, there are no regional-level data available on healthcare expenditures or mortality-based measures such as life expectancy. The lack of a central repository of regional-level data is a significant impediment to measuring health system efficiency in Canada.

The review of the empirical literature identified a third area where there is a lack of consensus, namely on the methodological approach that should be taken to measure inputs and outputs and to relate them to one another (Box 3). In the 56 health-system level analyses, the following methodological approaches were chosen:

- 35 studies used data envelopment analysis;
- 17 studies used stochastic frontier analysis;
- two studies used both data envelopment analysis and stochastic frontier analysis,(9;10) the advantage of which is that it offers insight into the sensitivity of the empirical results to the choice of method;
- nine studies used regression analysis; and
- four studies used other methods.

The numbers do not add to 56 because an analysis could use more than one methodological approach.

A simple regression analysis using data drawn from these 40 analyses – unit of analysis, type of input and output measures used, method used, and year and type of publication – demonstrated that the choice of the inputs or outputs is not correlated with the method used.

Box 3: Technical background on methodological approaches

Staff of the Canadian Institute for Health Information identified that efficiency can be measured using two methodological approaches.

The first approach involves estimating the *average* relationship between inputs and outputs in a standard regression analysis. This approach helps to understand the effect of one input (e.g., number of nurses) on the measure of output (e.g., life expectancy). For example, using panel data one can (by estimating a country fixed effect and interacting it with the coefficients) measure differences in the rate of return of various inputs across countries (e.g., increasing the number of nurses could have an effect on life expectancy in Canada, but not in the United States). Alternatively, using a quantile regression analysis, one can examine the response curve of the outcome to the level of input (instead of just examining the linear relationship at the sample average).

The second approach involves estimating a frontier, meaning that it calculates a *maximum* or *optimal* level of performance. This approach can use:

- a non-parametric method, specifically a data envelopment analysis; and
- a parametric method that is very close to a regression model, but that focuses on the residual (error term) instead of the average relationship between independent and dependent variables, and which is called a stochastic frontier analysis.

A data envelopment analysis does not require any strong assumptions about the nature of the relationship between inputs and outputs. However, it is highly sensitive to extreme cases (specifically ‘over-performers’) who are the ones setting the frontier. Moreover, it attributes any gap between the frontier and the observed achievement to inefficiency. A stochastic frontier analysis, on the other hand, requires strong and often hard-to-justify assumptions about the nature of the relationship between inputs and outputs, as well as about the distribution of the error term. It can be biased by ‘under-performers’ but it is not sensitive to outliers to the same extent as data envelopment analysis, and it allows the analyst to separate false from true efficiencies.

THREE ELEMENTS OF A MODEL OF HEALTH SYSTEM EFFICIENCY

Developing and using a model of health system efficiency requires that agreement be reached about the elements of a model. For the purpose of this issue brief, we have grouped a number of sub-elements into three broad elements: 1) establish a clear objective for the health system; 2) establish clear boundaries for the health system; and 3) select appropriate methods and collect appropriate data for measuring efficiency. In this section of the issue brief we review available data and research evidence about each element in turn.

Element 1 – Establish a clear objective for the health system

Measuring health system efficiency requires first and foremost an agreement about the objective – and more specifically an output measure – for the health system. The first choice that one faces is among:

1. delivering healthcare services, which means the output measure is the number of a given deliverer of services or the number of services;
2. improving health (including for the healthy), which means the output measure is the combination of life expectancy and disability (e.g., infant mortality in low-income countries, where there is significant variation in the measure, and disability-adjusted life expectancy, which can be abbreviated as DALE and is more commonly used in high-income countries); and
3. providing access to effective treatments for those who are sick, which means the output measure is avoidable mortality or potential years or life lost (which can be abbreviated as PYLL).

The second choice that one faces is between:

- a. maximizing outputs (which is typically operationalized in terms of option 2 above, and specifically as maximizing average population health); and
- b. reducing inequalities in outputs (which is also typically operationalized in terms of option 2, and in this case as reducing inequalities in population health across income or other groups).

Three sources of information can inform deliberations about the optimal objective for the health system:

- a review of the academic literature, which has been foreshadowed in the problem section of this issue brief;
- interviews with senior civil servants in Canadian provincial and territorial governments; and
- a review of publicly available documents produced by Canadian federal, provincial and territorial governments.

While these are by no means the full spectrum of stakeholders – citizens (and their elected representatives) being the group most notably lacking – they do provide a starting point for deliberations about the objective for the health system.

Insights from the academic literature

The advantages and disadvantages of objective 1 (and its corresponding output measure) – delivering healthcare services (number of a given deliverer of services or the number of services) – include:

- appropriately focuses attention on volume of activity, albeit under the assumption that healthcare providers always provide the optimal combination of visits and stays for a given treatment;
- avoids second-guessing healthcare providers by taking what they think best as an ethical constraint of the health system;
- does not represent well what the health system seeks to produce (it values a doctor visit or hospital stay as opposed to the health outcomes derived from these activities); and
- rewards health systems with too much activity (i.e., those that could achieve the same level of health for patients with less activity) and penalizes health systems that use the minimum activity needed to improve health.

The pros and cons of objective 2 (and its corresponding output measure) – improving health (disability-adjusted life expectancy or DALE) – include:

- gives attention to both mortality and disability (or health-related quality of life) by weighting individuals' year of life by their quality of life (e.g., if all individuals are born in perfect health, become disabled – with their health status deemed equivalent to half the quality of perfect health – at age 50 and die at age 100, their life expectancy is 100, but their DALE is 75);
- measures quality of life (using techniques such as the time trade-off method) relative to an abstract ideal of 'perfect health;'
- attributes all mortality and disability to a failure of the health system (e.g., a health system in a country with a higher proportion of obese people or smokers will be considered less efficient if it uses the same amount of resources as a health system in a country with a lower proportion), instead of focusing on changes to health at the margin from access to effective treatments; and
- assumes that individuals adopt an ex-ante perspective on treatments (i.e., what individuals expect from the health system before they are diagnosed with a condition) whereas it tends to be an ex-post perspective (i.e., what individuals expect from the health system once they have been diagnosed) that drives decisions.(11;12)

The last point has been called the 'dead-anyway effect,' meaning that individuals would be willing to pay much more for care that might extend their life once they have been diagnosed with a potentially fatal disease, given that their wealth will be useless to them if they die.(13)

The advantages and disadvantages of objective 3 (and its corresponding output measure) – providing access to effective treatments for those who are sick (potential years of life lost or PYLL) – are in many ways the opposite of those for objective 2:

- does not attempt to compare health states to 'perfect health;'
- can be focused on diagnoses specifically amenable to healthcare (and indeed it can be seen as a weighted average of disease-based measures of efficiency that focus on the years of life that the health system can save by, for example, appropriately treating those with cancer or who have had a stroke);
- gives attention to what individuals expect from the health system once they have been diagnosed; and
- focuses on mortality only and not both mortality and disability.

To illustrate the consequences of choosing between objectives 2 and 3, consider the case of two countries that spend the same amount of money per capita on healthcare, with country 1 using some of the money to deter people from smoking and country 2 using some of the money to provide effective treatments to smokers when they are sick. Using objective 2 one would conclude that country 1 – with higher life expectancy given the reduction in smokers – is more efficient. On the other hand, using objective 3 one might conclude that country 2 – with smokers or those who could have smoked (or whose children might start smoking) knowing that the system cured or could cure half of them – has the better health system.

For the same level of outcome (DALE or PYLL), most individuals would prefer a more even distribution of outcomes to a more unequal distribution. Here inequality can be measured as the concentration of health (a measure close to the variance of the distribution) or as its concentration with respect to a socioeconomic factor such as income (in which case a distribution would be considered unequal when the health – DALE or PYLL – of the poor is much worse than the health of the rich. When faced with the choice between objective a – maximizing average population health – and objective b – reducing inequalities in population health across income or other groups – we can consider three situations:

- sicker or poorer individuals have a *greater* capacity to benefit from healthcare or they use *fewer* resources for the same level of need, in which case there is no trade-off between objectives a and b (directing more resources toward those less well off will increase average population health) and here the typical measure of combined output is the composite measure (a weighted sum of the average output measure and the equality measure);

- sicker or poorer individuals have a *lower* capacity to benefit from healthcare or they use *more* resources for the same level of need, in which case there is a trade-off between objectives a and b (directing more resources toward those less well off will reduce average population health) and here the typical measure of combined output is the product of the average output measure and the equality measure (so that the number of units of health equality needed to compensate for a loss in one unit of average population health will increase as the initial level of average population health decreases); and
- equality is seen as a constraint rather than as an objective, so that, for example, the health system's goal is to improve DALE or reduce PYLL, subject to the constraint that the sick or poor do not fare worse. Such a perception seems to emerge from the interviews with the stakeholders: they rarely mention equality, and when they do, it is mostly as a constraint.

A measure such as PYLL incorporates some equality considerations, because in focusing on years of life lost before age 75, which is an age reached by two-thirds of Canadians, it can be said to measure access to effective treatments among the least-favoured third of the population. The WHO 2000 report is an example of the relatively small number of studies of health system efficiency that account for inequality in the distribution of health outcomes.(2)

Insights from interviews with civil servants

As Smith and Street (2006) suggest, “someone on behalf of society has to decide what objectives ought to be pursued. That is rarely a role for analysts or researchers – rather, it is the legitimate role of politicians. In developing a performance model, an important requirement is to seek out a clear political statement on what is valued from legitimate stakeholders.”(14)(p. 319-320)

There appears to be widespread agreement among the senior civil servants who were interviewed (Box 4) that the primary objective for the health system is to provide access to effective treatments for those who are sick (i.e., objective 3), whereas maximizing average population health (i.e., objective a) and reducing inequalities in population health across income or other groups (i.e., objective b) were often stated as secondary objectives. Indeed, objectives related to the healthcare delivery system (especially diagnosing and treating illness and ensuring that healthcare is available when and where it's needed) were mentioned almost twice as frequently as objectives related to health, even though a number of civil servants expressed their unease with or resignation to having healthcare objectives trump health objectives.

Similarly, output measures related to the healthcare delivery system (especially accessibility/timeliness and quality/safety, as opposed to what was described as the historical focus on activity volumes) were discussed much more frequently than output measures related to health (such as health status improvement) or accountability (such as reducing waste and getting value for money). There was no clear consensus about the ‘most important’ healthcare delivery outcome and some concerns were expressed about the public prioritizing accessibility/timeliness over quality and safety.

Box 4: Soliciting input from senior civil servants in Canadian provincial and territorial governments

A qualitative study was conducted by McMaster University's Julia Abelson, with funding from the Canadian Institute for Health Information as part of this project, to identify, explore and better understand health civil servants' views on the subject of measuring health system efficiency. A descriptive, qualitative methodology was employed with key informant interviews as the data-collection method. The sampling frame for the study included current and former senior health ministry officials across all Canadian provinces and territories in Deputy Minister, Assistant/Associate Deputy Minister, Executive Director or Director positions, and/or with portfolios relevant to health system efficiency. The interview guide focused on two principal topics: the objectives and outputs of provincial/territorial health systems and the health system inputs required to achieve them. Sixteen semi-structured interviews were conducted with senior health ministry personnel from seven provinces and two territories. Two individuals were involved in the thematic coding of the interview transcripts.

Civil servants' comment about the trade-offs that are made between different objectives and output measures within their respective health ministries could be grouped into three categories:

- types of trade-offs that are (or are not) made (primarily between the acute care system and other parts of the health system, and secondarily between accessibility and quality, with acute care and accessibility tending to be prioritized over other parts of the health system and quality, respectively);
- processes through which trade-offs occur (primarily in the context of budget making and at the cabinet table); and
- key barriers to making trade-off decisions (e.g., not using the available research evidence, limited analytic capacity arising from a lack of integrated information systems and real-time metrics, a bias towards universality, and a lack of political will).

Insights from the documentary analysis

Turning from what civil servants say to what appears in publicly available government documents (Box 5), the key findings from the documentary analysis at the **provincial and territorial level** include that:

- there was a mix of objectives related to maximizing average population health and enhancing system performance;
- there was relatively little attention given to reducing inequalities, although there were some examples of explicit statements about this as well as about improving the health of specific populations;
- statements related to ensuring accountability and sustainability were more common in federal government documents than provincial and territorial government documents; and
- there were frequent disconnections between statements of system objectives and the performance measures being used, with many documents that focused on maximizing average population health actually describing performance measures related to system performance.

Below we address each of the five themes in turn, as they were addressed in provincial and territorial government documents, and then we address the themes that emerged in federal government documents.

Box 5: Identifying insights from publicly available documents prepared by Canadian federal, provincial and territorial governments

A documentary analysis was conducted by staff of the Canadian Institute for Health Information to identify insights about or relevant to measuring health system performance and efficiency. A descriptive, qualitative methodology was employed with documentary review as the data-collection method. The sampling frame for the study included documents that addressed health systems administration, functions and delivery, and that were produced by Canadian federal, provincial and territorial governments. Federal government documents were identified based on staff's knowledge of the field and the reference lists of included documents. Provincial government reports were identified based on a review of websites. Examples of reviewed documents include annual reports, legislation, strategic planning documents, and planning or measurement frameworks.

The documentary analysis template focused on two principal topics – the stated objectives (or goals, mandates and visions) for the health system and the connection between these objectives and the performance measures being used – but was refined iteratively as the analysis progressed. The stated objectives were initially grouped by

- **maximizing average population health** - statements that focus on obtaining the healthiest population possible, with a focus on disease prevention, health promotion and improving outcomes (e.g., life expectancy, quality of life and well-being) for the whole population;
- providing access to effective treatments for those who are sick (or **enhancing system performance**) - statements that focus on avoiding or reducing risk and improving the situation of those who are ill through quality care, system improvements, allocation of resources and performance measurement; and
- **reducing inequalities** in population health across income or other groups - statements that focus on reducing inequalities in health status or decreasing disparities that exist between populations with respect to health outcomes or access to healthcare, as well as statements that explicitly mention improving the health of a particular group or population.

Two additional themes were later added:

- **balancing priorities** - statements that explicitly discuss the importance of achieving an appropriate balance between population-health oriented goals and system performance-oriented goals; and
- **ensuring accountability and sustainability** - statements that focus on being responsive to public needs and the best available research evidence, accountability, sustainability, and the principles of the Canada Health Act (universality, portability, comprehensiveness, accessibility and public administration).

With regard to the objective of **maximizing average population health status**, statements typically mentioned optimal health and well-being,(15-17) and to a lesser extent quality of life when adapting to disability, illness or aging.(18) The documentary analysis also revealed some additional, less common objectives, including:

- enabling health-promoting behaviour and healthy or supportive communities/environments; (16;19;20)
- creating healthy public policy and supporting the social determinants of health;(21)
- preventing or controlling disease and injury;(22) and
- enhancing self-reliance.(23;24)

Turning to the objective of **enhancing system performance**, statements focused most commonly on improving accessibility to healthcare,(15;22;25;26) as well as improving the quality or effectiveness of healthcare.(18;20;22) Less commonly cited objectives included:

- improving continuity of care;(27)
- integrating services and establishing shared responsibility for service delivery;(25)
- making healthcare more patient-centred;(26)
- enhancing cost effectiveness and efficiency;(16)
- providing alternative forms of care;(21)
- stimulating innovation;(18) and
- providing timely and appropriate care.(28)

On the theme of **balancing priorities**, governments differed in whether their documents:

- included explicit statements about balancing priorities; or
- implicitly appeared to endorse balancing priorities given how they include a mix of statements about both maximizing average population health and enhancing system performance.

Two governments illustrate the more explicit approach: 1) “Healthy Manitobans through an appropriate balance of prevention and care;”(29) and 2) “The Minister shall develop and implement programs and services to protect, promote, and restore the health and the social well-being of the people of the Yukon.”(30) Other governments used a more implicit approach, with the mix of statements sometimes reflecting the part of government that issued the report. For example, provincial governments with both a ministry focused on health and wellness and a ministry focused on healthcare, such as Ontario and British Columbia, tended to have statements about maximizing average population health issued by the former and statements about enhancing system performance issued by the latter. As another example, provincial governments with a separate health quality council, such as Ontario and Alberta, tended to have statements about ensuring accountability and sustainability issued by the health quality council.

Few statements addressed the theme of **ensuring accountability and sustainability** and these were mainly found in health quality council resources in jurisdictions like Ontario and Alberta,(31;32) and addressed themes such as:

- accountability;(15)
- evidence-based planning and decision-making;(25)
- public expectations and engagement;(16;33)
- sustainability;(34) and
- valuing or respecting diversity.(24)

Regarding the theme of **reducing inequalities**, there was a mix of statements about:

- reducing inequality; and
- identifying and meeting the needs of vulnerable populations.

For example, some provincial and territorial reports refer to “reducing inequalities in health status,”(16) “ensuring equitable and quality services,”(15) or “equity” as a goal or vision for the health system,(25) whereas others refer to providing better care for specific populations,(35) in one case explicitly mentioning

seniors, children, people at risk of abuse, and those with disability or illness (especially chronic conditions or mental illness/addictions).(15) While equity-related statements were identified in all provinces and territories, statements in this category were limited in number compared to the other categories. Moreover, only British Columbia and New Brunswick included an equity dimension (specifically indicators related to vulnerable populations) in their performance frameworks.(20;36)

Notwithstanding the broad array of stated objectives and themes identified in the government reports, the performance framework categories were much more likely to address system performance than any other objective or theme.

Turning now to the key findings from the documentary analysis at the **federal level**, where fewer documents were available, many statements described elements of a vision for the health system:

- overall health and reaching one's fullest potential;(37;38)
- Canada Health Act principles of universality, comprehensiveness, accessibility, portability and public administration;(39)
- effectiveness and safety;(40;41)
- sustainability;(41;42)
- fairness;(40;41;43) and
- accountability.(40;41)

The most commonly cited objectives for the health system were the five Canada Health Act principles, with particular attention given to ensuring timely access to healthcare regardless of ability to pay and avoiding financial hardship as a result of paying for healthcare.(39;41;43;44)

While framed as public health goals and not health system objectives, the federal, provincial and territorial report entitled *Health Goals for Canada*, which was released in 2005 following an extensive consultation and validation process, includes the health system as one of the four headings for its objectives, one of which explicitly calls for “a strong system for health and social well-being responds to disparities in health status and offers timely, appropriate care.”(37)

Additional findings from the federal level include:

- there was a mix of statements related to maximizing average population health and reducing inequalities in population health across income or other groups;
- many more statements address ensuring accountability and sustainability than was the case at the provincial and territorial level;
- almost no statements addressed enhancing system performance as an objective; and
- system performance was frequently used in performance measurement frameworks (despite the frequent mentions of other objectives and the infrequent mentions of this objective).

We summarize the above findings in Table 1 below, which presents the choice of objective in terms of a choice between columns.

Table 1: Summary of key findings from the literature, interviews and documents relevant to Element 1 – Establish a clear objective for the health system

Category of finding	Summary of key findings about potential output measures related to:		
	Maximizing average population health (i.e., DALE)	Enhancing system performance (i.e., PYLL)	Reducing inequalities (which can be combined with either of the other two objectives)
Advantages	<ul style="list-style-type: none"> gives attention to both mortality and disability (literature) is mentioned alongside system performance as a health system objective (documents) rarely mentioned as a performance framework category even when mentioned as a health system objective (documents) 	<ul style="list-style-type: none"> does not attempt to compare health states to ‘perfect health’ (literature) can be focused on diagnoses specifically amenable to healthcare (literature) gives attention to what individuals expect from the health system once they have been diagnosed (literature) is mentioned almost twice as frequently as health as an objective of the health system (interviews) is mentioned much more frequently as the focus of output measures (interviews) is mentioned at the provincial/territorial level alongside population health as a health system objective, but rarely at the federal level (documents) is mentioned much more frequently as a performance framework category at both provincial/territorial and federal levels (documents) 	<ul style="list-style-type: none"> is mentioned infrequently as a health system objective (documents) is mentioned both in relation to reducing inequality and identifying and meeting the needs of vulnerable groups (documents)
Disadvantages	<ul style="list-style-type: none"> measures quality of life relative to an abstract ideal (literature) attributes all mortality and disability to a failure of the health system (literature) assumes the individuals adopt an ex-ante perspective on treatments (literature) 	<ul style="list-style-type: none"> focuses on mortality only and not both mortality and disability (literature) 	<ul style="list-style-type: none"> requires a trade-off between maximizing health and reducing inequalities if sicker or poorer individuals have a lower capacity to benefit from healthcare or they use more resources for the same level of need (literature)

Element 2 – Establish clear boundaries for the health system

Measuring health system efficiency also requires an agreement about the boundaries for the health system, by which we mean both the inputs available to the system and the environmental constraints under which it must work.

The first choice that one faces is among inputs (i.e., those factors that lie within the control of health system decision-makers):

1. all elements of the health system, which WHO defines as “all the organizations, institutions and resources that are devoted to producing health actions,” and it defines a health action as “any effort, whether in personal health care, public health services or through intersectoral initiatives, whose primary purpose is to improve health;”(2)(p. xi)
2. countable physical inputs to the health system (i.e., capital and labour); and
3. costs of the inputs to the health system (i.e., total healthcare expenditures).

A related choice includes whether we are interested in short-term efficiency (in which case we could focus on, for example, those providers currently working in the system) or long-term efficiency (in which case we could also focus on those providers being trained to work in the system).

The second choice that one faces is among environmental constraints (i.e., those factors that lie outside the control of health system decision-makers). Examples of possible constraints include:

1. proportion of smokers in the population;
2. level of education achieved in the population; and
3. level of income or extent of income inequality in the population.

Other possible environmental constraints include:(45):

- additional characteristics of citizens being served (beyond smoking status and educational level), although there is considerable debate about which characteristics are considered to be ‘controllable’;
- additional characteristics of the external environment (beyond the extent of income inequality), such as culture, economic conditions and geography;
- activities in other related agencies, both within and beyond the health sector, such as community care agencies and housing organizations;
- previous organizational efforts in disease prevention and health promotion; and
- quality of resources being used (e.g., capital stock, including hospitals), which in the short term at least is not within the control of health system decision-makers.

The same two sources of information drawn upon in the last section can also inform deliberations about the inputs to and environmental constraints in the health system, as well as how to measure them:

- a review of the academic literature, which has been foreshadowed in the problem section of this issue brief; and
- interviews with senior civil servants in Canadian provincial and territorial governments.

Insights from the academic literature

The advantages and disadvantages of input type 1 (all elements of the health system, even including those involved in the production of resources,(46) such as the funding for medical schools) include:

- provides a holistic assessment of inputs; and
- is limited by the availability of data and feasibility of managing it all.

The pros and cons of input type 2 (countable physical inputs to the health system) include:

- can often be measured with some degree of accuracy;

- answers the technical efficiency question about whether the output would be produced with fewer hospital beds, supplies or people's time;(47)
- reflects what decision-makers can alter relatively easily; and
- captures true efficiency improvements and not simply changes to the dollar value associated with particular inputs (e.g., by paying nurses less).

The advantages and disadvantages of input type 3 (costs of the inputs to the health system) include:

- can often be measured with some degree of accuracy, can capture differences in quality among inputs of the same type, and can be aggregated into a single unit;(14)
- answers the cost efficiency question about whether the output could be produced with a less expensive combination of inputs;(47)
- doesn't reflect what decision-makers can alter relatively easily (e.g., it can be very hard to reduce physician salaries); and
- captures changes to the dollar value associated with particular inputs, which may not reflect true efficiency improvements.

Turning now to the first of three examples of possible environmental constraints, the advantages of *not* including the proportion of smokers in the population – in a model of efficiency that includes a measure of health as the outcome and allows for such constraints affecting the way inputs are converted into outcomes, such as the one in the WHO 2000 report (2) – include:

- acknowledges that health systems have (at least some) responsibility for the proportion of smokers in the population (and hence systems with high proportions are seen as less efficient);
- systems with more favourable environments will not be advantaged in the calculation.

Similar examples include drinking, violence and epidemics such as HIV/AIDS.(48)

The advantages of including the level of education achieved in the population as an environmental constraint (as was done in the WHO 2000 report)(2) include:

- suggests that health systems don't have responsibility for the level of education, but that levels of education may affect the ability of the health system to use inputs to achieve their desired objectives; and
- systems operating in countries with better educated populations (such as Canada) will be deemed less efficient than systems operating in countries with less educated populations (such as France) even if they achieve the same life expectancy with the same level of expenditures.

The pros and cons of including the level of income or the extent of income inequality in the population as an environmental constraint (which was not done in the WHO 2000 report) include:

- confirms the income and income inequality are beyond the reach of health systems, but that they can be an important determinant of health status; (49)
- could introduce multi-collinearity into the estimation.(2)

The review of the academic literature suggests that there is no consensus on how to define the inputs to and environmental constraints in the health system:

- 19 studies used physical resources as inputs, with the most frequently chosen ones being numbers of inpatient beds, nurses and physicians;
- 13 studies used monetary units (such as total dollar value of resources used in the system) as inputs;(2)
- 14 studies used both physical resources and monetary units (e.g., number of general practitioners, number of nurses and gross expenditure on general medical services, among others);(9)
- nine studies included education (including the eight that replicate WHO 2000 report methodology).

These choices appear to be made primarily on the basis of data availability and comparability.(7;8)

Insights from interviews with civil servants

Most civil servants identified inputs as human resources (e.g., nurses and doctors), financial resources (e.g., money spent on prescription drugs) and infrastructure (e.g., clinics, hospitals and long-term care homes).

Many environmental constraints were identified by civil servants, including health system structures and arrangements (e.g., influence of physicians and jurisdictional boundaries) and internal analytic and managerial capacity, however, they were typically not the types of constraints that can be considered in the context of a model of health system efficiency.

We summarize the key advantages and disadvantages of the available methods in Table 2 below. Unlike Table 1, where the choice was between columns, here choices need to be made within each column.

Table 2: Summary of key findings from the literature, interviews and documents relevant to Element 2 – Establish clear boundaries for the health system

Category of finding	Summary of key findings about potential:	
	Inputs available to the system (i.e., factors within the control of health system decision-makers)	Environmental constraints under which the system must work (i.e., factors outside the control of health system decision-makers)
Advantages	<ul style="list-style-type: none"> • All elements of the health system <ul style="list-style-type: none"> ○ provides a holistic assessment of inputs • Countable physical inputs to the system, which includes capital inputs (e.g., number of hospitals) and labour inputs (e.g., number of doctors) <ul style="list-style-type: none"> ○ can often be measured with some degree of accuracy; ○ answers the technical efficiency question ○ reflects what decision-makers can alter relatively easily ○ captures true efficiency improvements and not simply changes to the dollar value associated with particular inputs (e.g., by paying nurses less) ○ used in many empirical assessments ○ identified as inputs by many civil servants (interviews) • Healthcare expenditures (e.g., dollars spent) <ul style="list-style-type: none"> ○ can often be measured with some degree of accuracy, can capture differences in quality among inputs of the same type, and can be aggregated into a single unit ○ answers the cost efficiency question about whether the output could be produced with a less expensive combination of inputs ○ used in many empirical assessments ○ identified (in the form of provincial and federal funding) as inputs by some civil servants (interviews) 	<ul style="list-style-type: none"> • ‘Non-controllable’ characteristics of citizens being served (e.g., education level, but not smoking status, drinking status, violence or epidemics) <ul style="list-style-type: none"> ○ suggests that health systems don’t have responsibility for the characteristics, but that they may affect the ability of the health system to use inputs to achieve their desired objectives ○ used in many empirical assessments ○ identified (in the form of socioeconomic status, lifestyles and possibly public demand for new and costly technology) by many civil servants (interviews) • Characteristics of the external environment (e.g., income inequality, culture, economic conditions, geography) <ul style="list-style-type: none"> ○ as above • Activities in other related agencies (e.g., community care agencies, housing organizations) <ul style="list-style-type: none"> ○ as above ○ identified (in the form of the power of physician groups and the relationships between ministries of health and health regions) by civil servants (interviews) • Previous organizational efforts in disease prevention and health promotion <ul style="list-style-type: none"> ○ as above • Quality of resources being used (e.g., capital stock, including hospitals) <ul style="list-style-type: none"> ○ as above
Disadvantages	<ul style="list-style-type: none"> • All elements of the health system <ul style="list-style-type: none"> ○ is limited by the availability of data and feasibility of managing it all ○ not used in any empirical assessments • Countable physical inputs to the system, which includes capital inputs (e.g., number of hospitals) and labour inputs (e.g., number of doctors) <ul style="list-style-type: none"> ○ no disadvantages identified • Healthcare expenditures (e.g., dollars spent) <ul style="list-style-type: none"> ○ doesn’t reflect what decision-makers can alter relatively easily (e.g., it can be very hard to reduce physician salaries) ○ captures changes to the dollar value associated with particular inputs, which may not reflect true efficiency improvements 	<ul style="list-style-type: none"> • ‘Non-controllable’ characteristics of citizens being served (e.g., education level, but not smoking status, drinking status, violence or epidemics) <ul style="list-style-type: none"> ○ systems with more favourable environments will be deemed less efficient than systems operating in countries with less favourable environments even if they achieve the same objectives with the same level of expenditures • Characteristics of the external environment (e.g., income inequality, culture, economic conditions, geography) <ul style="list-style-type: none"> ○ could introduce multi-collinearity into the estimation • Activities in other related agencies (e.g., community care agencies, housing organizations) <ul style="list-style-type: none"> ○ as above • Previous organizational efforts in disease prevention and health promotion <ul style="list-style-type: none"> ○ as above • Quality of resources being used (e.g., capital stock, including hospitals) <ul style="list-style-type: none"> ○ as above

Note that all findings derive from the academic literature unless otherwise noted.

Element 3 – Select appropriate methods and collect appropriate data for measuring efficiency

Measuring health system efficiency also requires an agreement about methods and the available data to execute the methods. As described in box 3, the choice of methods is between:

- methods that estimate the average relationship between inputs and outputs;
- methods that estimate a maximum or optimal level of performance, and specifically:
 - data envelopment analysis, and
 - stochastic frontier analysis.

The box also describes their uses, assumptions and sensitivities.

Of the three sources of information available to us, only the academic literature can inform deliberations about the optimal method. As we described in the introduction, a review of 56 empirical health-system level analyses demonstrated the lack of consensus about methods, although there was a clear preponderance of studies using data envelopment analysis (n=35), stochastic frontier analysis (n=17) or both (n=2). As well, the choice of the inputs and outputs was not found to be correlated with the method used.

We summarize the key advantages and disadvantages of the available methods in Table 3 below, where the choice needs to be made between columns (and possibly within the final column).

Table 3: Summary of key findings from the literature, interviews and documents relevant to Element 3 – Select appropriate methods and collect appropriate data for measuring efficiency

Category of finding	Summary of key findings about potential:	
	Methods that estimate the average relationship between inputs and outputs	Methods that estimate a maximum or optimal level of performance
Advantages	<ul style="list-style-type: none"> • Regression <ul style="list-style-type: none"> ○ can be used to examine the unique effect of one input on a measure of output in different health systems and to examine the response curve of the outcome to the level of input 	<ul style="list-style-type: none"> • Data envelopment analysis <ul style="list-style-type: none"> ○ requires no strong assumptions about the functional relationship between inputs and outputs • Stochastic frontier analysis <ul style="list-style-type: none"> ○ isn't sensitive to outliers to the same extent as data envelopment analysis ○ allows the analyst to disentangle random errors from inefficiencies (a systematic gap between observed performance and the frontier)
Disadvantages	<ul style="list-style-type: none"> • Regression <ul style="list-style-type: none"> ○ focuses on the average level of performance instead of the maximum or optimal level 	<ul style="list-style-type: none"> • Data envelopment analysis <ul style="list-style-type: none"> ○ is highly sensitive to outliers (specifically 'over-performers') who are the ones setting the frontier ○ attributes any gap between the frontier and the observed achievement to inefficiency • Stochastic frontier analysis <ul style="list-style-type: none"> ○ requires strong and often hard-to-justify assumptions about the functional relationship between inputs and outputs, as well as about the distribution of the error term ○ can be biased by 'under-performers'

As well, an internal review by staff of the Canadian Institute for Health Information identified that the key gaps in the data needed at the health region level to measure health system efficiency in Canada include:

1. missing public-sector healthcare expenditure data;
2. missing drug expenditure data;
3. missing expenditure data on nursing homes and residential care facilities at the health region level;
4. missing expenditure data on public health;
5. missing full-time equivalent physician counts (although counts of full-time equivalent personnel working in residential care settings are available from Statistics Canada);
6. missing data on other health professionals (chiropractors, dentists, optometrists, among others, which accounted for 10.8% of total healthcare expenditure in 2008);
7. missing data on licensed practical nurses and registered psychiatric nurses (which accounted for 25% of all regulated nurses) for years before 2003;
8. missing data on wait times (such as primary healthcare, emergency visits, certain procedures, etc); and
9. healthcare outcomes (life expectancy, potential years of life lost, etc.) are not available every year.

Gaps 1-8 relate to what we called objective 1 when discussing the first option (delivering healthcare services), gap 8 relates to what we have called objective 2 (improving health) and gap 9 relates to what we have called objective 3 (providing access to effective treatments for those who are sick). Gaps 1-7 relate to what we called inputs available to the system (i.e., factors within the control of health system decision-makers) but none of the gaps relate to the environmental constraints under which the system must work (i.e., factors outside the control of health system decision-makers), although presumably a number of additional gaps exist in this domain as well. None of the gaps relate specifically to the choice of method.

IMPLEMENTATION CONSIDERATIONS

As outlined in the introduction, there are many potential uses of a measure of health system efficiency

- policymakers and independent organizations (e.g., quality councils) could publicly report these measures to strengthen public accountability, and to identify room for improvement in health system performance; and
- policymakers could use these measures to enable greater accountability of health regions and to help health regions identify room for improvement.

However, arriving at a measure of health system efficiency that policymakers and others will use requires:

- policymakers and other stakeholders achieving consensus about the objective of the health system (and output measure), the inputs to the health system and the environmental constraints that can influence the efficiency of the health system, and the methodological approach that should be taken to measure inputs and outputs and to relate them to one another; and
- policymakers and other stakeholders advocating for improved and more comprehensive collection (and sharing) of data, particularly at the level of health regions, in order to empirically analyse efficiency and its determinants.

We describe below some barriers to developing and using a model of health system efficiency as a way to spur reflection about some of the considerations that may influence choices among approaches (Table 4).

Table 4: Potential barriers to developing and using a model of health system efficiency

Levels	Element 1 – Establish a clear objective for the health system	Element 2 – Establish clear boundaries for the health system	Element 3 – Select appropriate methods and collect appropriate data for measuring efficiency
Citizen/patient	<ul style="list-style-type: none"> • Citizens can't relate to the chosen objective (or output measure) 	<ul style="list-style-type: none"> • Citizens remain focused on inputs that they can relate to (e.g., number of doctors) 	<ul style="list-style-type: none"> • Citizens can't easily grasp the messages arising from the use of complicated methods
Service provider	<ul style="list-style-type: none"> • Providers can't relate to the chosen objective (or output measure) 	<ul style="list-style-type: none"> • Providers remain focused on inputs that involve them and don't acknowledge environmental constraints 	<ul style="list-style-type: none"> • Providers can't easily grasp the messages arising from the use of complicated methods
Organization	<ul style="list-style-type: none"> • Health regions disagree with the use of an objective (or output measure) that doesn't align with their own 	<ul style="list-style-type: none"> • Health regions disagree with the choice of inputs or environmental constraints that don't align with their own definitions 	<ul style="list-style-type: none"> • Health regions can't easily grasp the messages arising from the use of complicated methods • Health regions refuse to allow their data to be used in health systems efficiency analyses
System	<ul style="list-style-type: none"> • Policymakers disagree with the notion of health system efficiency measurement or to the use of an objective (or output measure) that doesn't align with their own (and hence don't share their data or don't plan to use the model) 	<ul style="list-style-type: none"> • Policymakers disagree with the notion of health system efficiency measurement or to the choice of inputs or environmental constraints that don't align with their own (and hence don't share their data or don't plan to use the model) 	<ul style="list-style-type: none"> • Policymakers can't easily grasp the messages arising from the use of complicated methods • Policymakers refuse to allow their data to be used in health systems efficiency analyses

Two implementation strategies could help to address many of these barriers:

- 1) an iterative process of experimenting with particular choices of health system objective, inputs, environmental constraints and methods along with a concerted effort to engage key stakeholders in drawing lessons for next steps; and
- 2) a robust communications plan that gives significant attention to communicating clearly the key messages arising from the effort and to providing briefings to key health system leaders at the federal, provincial/territorial and regional levels prior to the public release of the results so that they can be well prepared for dealing with stakeholders and the media.

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