HEALTH SYSTEMS AND POLICY ANALYSIS

POLICY BRIEF 27

How to make sense of health system efficiency comparisons?

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This policy brief is one of a new series to meet the needs of policy-makers and health system managers. The aim is to develop key messages to support evidence-informed policy-making and the editors will continue to strengthen the series by working with authors to improve the consideration given to policy options and implementation.

What is a Policy Brief?

A policy brief is a short publication specifically designed to provide policy-makers with evidence on a policy question or priority. Policy briefs:

- Bring together existing evidence and present it in an accessible format
- Use systematic methods and make these transparent so that users can have confidence in the material
- Tailor the way evidence is identified and synthesised to reflect the nature of the policy question and the evidence available
- Are underpinned by a formal and rigorous open peer review process to ensure the independence of the evidence presented.

Each brief has a one page key messages section; a two page executive summary giving a succinct overview of the findings; and a 20 page review setting out the evidence. The idea is to provide instant access to key information and additional detail for those involved in drafting, informing or advising on the policy issue.

Policy briefs provide evidence for policy-makers not policy advice. They do not seek to explain or advocate a policy position but to set out clearly what is known about it. They may outline the evidence on different prospective policy options and on implementation issues, but they do not promote a particular option or act as a manual for implementation.

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How do Policy Briefs bring the evidence together?

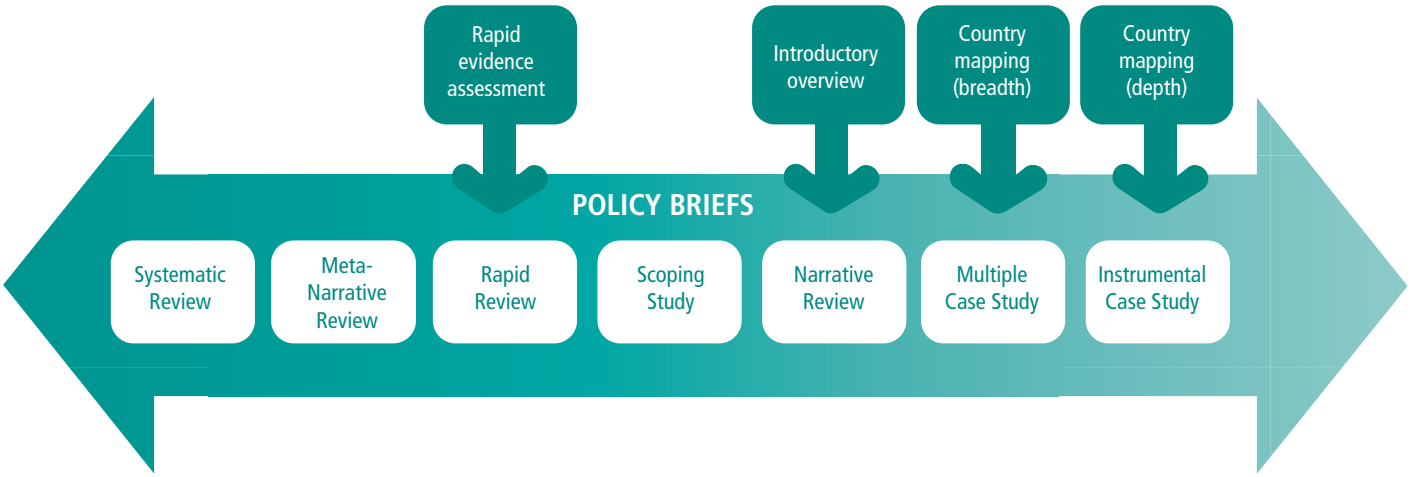
There is no one single way of collecting evidence to inform policy-making. Different approaches are appropriate for different policy issues, so the Observatory briefs draw on a mix of methodologies (see Figure A) and explain transparently the different methods used and how these have been combined. This allows users to understand the nature and limits of the evidence.

There are two main 'categories' of briefs that can be distinguished by method and further 'sub-sets' of briefs that can be mapped along a spectrum:

- **A rapid evidence assessment:** This is a targeted review of the available literature and requires authors to define key terms, set out explicit search strategies and be clear about what is excluded.
- **Comparative country mapping:** These use a case study approach and combine document reviews and consultation with appropriate technical and country experts. These fall into two groups depending on whether they prioritize depth or breadth.
- **Introductory overview:** These briefs have a different objective to the rapid evidence assessments but use a similar approach. Literature is targeted and reviewed with the aim of explaining a subject to 'beginners'.

Most briefs, however, will draw upon a mix of methods and it is for this reason that a 'methods' box is included in the introduction to each brief, signalling transparently that methods are explicit, robust and replicable and showing how they are appropriate to the policy question.

Figure A: The policy brief spectrum



Source: Erica Richardson

Acronyms

DEA	data envelopment analysis
DRG	diagnosis-related group
EQ-5D	EuroQol Five Dimensions questionnaire
OECD	Organisation for Economic Cooperation and Development
PPP	purchasing power parity
PROM	patient-reported outcome measure
QALY	quality-adjusted life year
SF-36	Short Form-36
WHO	World Health Organization

Boxes, tables and figures

Boxes

Tables

Figures

Key messages

- The inexorable growth in health expenditure has led to a widespread demand for efficiency improvements.
- There is no single metric or set of indicators that will give the complete picture of health system efficiency in a country.
- The real causes of any identified inefficiencies need to be carefully identified and analysed to inform good policy-making.
- More nuanced indicators require more standardized and detailed cost accounting data and linked datasets and registries.
- This policy brief gives a useful framework for understanding and interpreting the healthcare efficiency metrics that are widely used.

Executive summary

There is ample evidence to suggest that inefficiency is a major problem in all health systems. Identifying variability in efficiency is therefore of great importance, and becomes increasingly relevant to health systems grappling with significant or sudden resource constraints.

But how exactly can we understand and evaluate efficiency in health systems? Although the core idea of efficiency is easy to understand in principle – maximizing valued outputs relative to inputs, or vice versa – in practice it can be challenging to measure and interpret metrics, as well as to identify a course of action to remedy any observed inefficiencies.

In this brief we propose and apply an analytic framework that seeks to facilitate the interpretation of health system efficiency measures. We recommend that for any efficiency indicator, five aspects should be explicitly considered:

- the **entity** to be assessed
- the **outputs** (or outcomes) under consideration
- the **inputs** under consideration
- the **external influences** on attainment
- the **links with the rest of the health system**.

By thinking through each of these in detail, we argue that it becomes easier to understand, interpret and respond to variability in health system efficiency measures.

For instance, it may be that the accountable **entity** responsible for the observed production of health care outputs or outcomes is not obviously identifiable. Likewise, it may be that an indicator is impaired by some of the numerous, well-known challenges associated with measuring and matching the **inputs** and **outputs** of health care organizations. Furthermore, measurement may be complicated by **external influences** that have effects on health. The health sector has little direct opportunity to influence many of these factors, such as social determinants of health, so in principle any measure of efficiency must take account of their impact on measured levels of attainment. Finally, there are important **links within the health system** itself that must be taken into account. It is quite conceivable that some components are functioning efficiently within an inefficient broader health system.

Recognizing that it will always be necessary to look at several metrics across various levels and sectors of the health system in order to determine the magnitude and nature of inefficiency, we apply the framework across a wide range of 16 indicators that capture various production processes within the health system. These include common measures, such as average length of patient stay, incidence of duplicate testing, expenditures per case and generic prescribing rates, as well as popular frontier-based methods. As an illustrative example, using Organisation for Economic Cooperation and Development (OECD) data, we apply the framework to explore the challenges associated with frontier-based cross-country efficiency comparisons at the system level. The framework helps to shed light on what each metric can and cannot reveal about health system efficiency, and provides guidance on how to pinpoint the sources of any observed variability.

Understanding how proficiently discrete processes within the health system are completed will offer important glimpses into how well the system functions and provide some evidence of where it may be possible to make efficiency gains. However, the difficulties in measuring and operationalizing efficiency metrics and practices across health systems have given rise to a number of efficiency myths and oversimplifications regarding how to improve health system efficiency, and even what it means to be efficient. To understand the many nuances of well-known statements about health system efficiency (as well as to dispel common health policy 'myths'), it is essential to review and fully understand the methodological techniques that are used to measure health system efficiency, as well as the ways in which efficiency metrics can be used to make well-informed policy and managerial decisions. These important topics are explored in detail in a full volume on measuring health system efficiency, produced by the European Observatory on Health Systems and Policies and entitled 'Health system efficiency: How to make measurement matter for policy and management' [1], as part of the Observatory's large programme of research on performance assessment [2,3]. Building on this work, in this policy brief we aim to provide a more nuanced approach towards the pursuit of efficiency – one that seeks to identify efficient practice and understand the reasons for inefficiency, allowing the reader to critically evaluate existing metrics and challenge persistent myths.

Policy brief

Introduction

Why is health system efficiency important?

Health system efficiency seeks to capture the extent to which the inputs to the health system, in the form of expenditures and other resources, are used to secure valued health system goals. Its pursuit is one of the central preoccupations of health policy-makers and managers, and is justifiably a cause for concern. In many other sectors of the economy, consumer preferences help to ensure that the most valued outputs are produced at market prices. However, there are numerous, well-known market failures in the health sector that mean that the traditional market mechanisms cannot work, allowing poor quality or inappropriate care to persist at high prices if no policy action is taken [4].

Inefficient use of health system resources poses serious concerns, for a number of reasons:

- It may limit health gains for patients who have received treatment, because they do not receive the best possible care available within the health system's resource limits.
- By consuming excess resources, inefficient treatment may deny treatment to other patients who could have benefited from treatment had resources been better used.
- Inefficient use of resources in the health sector may sacrifice consumption opportunities elsewhere in the economy, such as education.
- Particularly in higher income countries where public sources dominate funding for health, suboptimal use of resources may reduce society's willingness to contribute to the funding of health services, thereby harming social solidarity, health system performance and social welfare.

Therefore, as well as its instrumental value, tackling inefficiency has an important accountability value: to reassure payers that their money is being spent wisely, and to reassure patients, caregivers and the general population that their claims on the health system are being treated fairly and consistently. Also, health care funders (including governments, insurance organizations and households) are interested in knowing which systems, providers and treatments contribute the largest health gains in relation to the level of resources they consume. Efficiency becomes particularly important in light of financial pressures and concerns over the long-term financial sustainability of many health systems, as decision-makers seek to ensure and demonstrate that health care resources are put to good use. When used appropriately, efficiency indicators can be important tools to help decision-makers determine whether resources are allocated optimally, and to pinpoint which parts of the health system are not performing as well as they should be.

How is health system efficiency measured?

The measurement of health system efficiency is beguilingly simple, represented at its most straightforward as a ratio of resources consumed (health system inputs) to some measure of the valued health system outputs they create. In effect, this creates a generic metric of 'resource use per unit of health system output'. Yet putting this simple notion into practice can be complex. Within the health system as a whole, there is a seemingly infinite set of interlinked processes that could independently be evaluated and found to be efficient or inefficient. This has given rise to a plethora of apparently disconnected indicators that give glimpses of certain aspects of efficiency, but rarely offer a comprehensive overview.

Economists view the transformation of inputs into valued outputs as a 'production function', which indicates the maximum feasible level of output for a given set of inputs. Any level of production below that maximum is an indication of inefficiency [5]. The concept of a production function can be applied to the functioning of very detailed micro units (such as an individual physician's practice) through to huge macro units (such as the entire health system). Whatever level is chosen, the intention is to offer insights into the success with which health system resources are transformed into physical outputs (such as patient consultations), or (more ambitiously) into valued outcomes (such as improved health).

However, a health system may not perform as well as it could; processes in the health system may be inefficient for two distinct, but related, reasons. Firstly, health system inputs, such as expenditures or other resources, may be directed towards creating some outputs that are not priorities for society; for example, providing very high-cost end-of-life cancer treatments may create benefits for the individuals involved, but society may judge that the limited money available to the health system could be better spent on other interventions that create (in aggregate) larger health gains. Secondly, there could be waste of inputs in the process of producing valued health system outputs. Misuse of inputs at any stage of the production process will mean that there will be less output than could have been achieved for a given initial level of resources. If a health system does not secure the lowest cost of medicines and other inputs, less output in terms either of: 1) the quantity of patients treated; or 2) the quality of care provided, will be possible for a given level of expenditure. Economists refer to these as allocative efficiency and technical efficiency, respectively.

Allocative efficiency

Allocative efficiency can be used to scrutinize either the choice of outputs or the choice of inputs. On the output side, it examines whether limited resources are directed towards producing the 'correct' mix of health care outputs. On the input side it guides decisions about what to include or exclude from the package of benefits offered.

Allocative efficiency is central to the work of Health Technology Assessment agencies, which often use expected gains in quality-adjusted life years (QALYs) as the central measure of the benefits of a treatment, and 'cost per QALY' as a main cost–effectiveness criterion for determining whether or not to encourage the adoption of a new treatment or discourage an existing one. The assumption underlying this approach is that payers wish to see their financial contributions used to maximize health gain. Under these circumstances, a provider would not be allocatively efficient

if it produces treatments with low levels of cost–effectiveness, because the inputs used could be better deployed producing outputs with higher potential health gains.

Allocative efficiency can also be considered at a broad sectoral level to examine whether the correct mix of health services is funded, so that at a given level of total expenditure, health outcomes are maximized. For example, an allocatively efficient health system allocates funds between sectors like prevention, primary care, hospital care and long-term care to maximize health-related outcomes in line with societal preferences. Allocative efficiency indicators at this level should indicate whether a health system is performing poorly because of a misallocation of resources between sectors. Metrics such as excessive antibiotic prescribing, or excessive referrals to hospital specialists, might be indicators of allocative inefficiency.

Allocative efficiency can also examine whether an optimal mix of inputs has been used – for example, the mix of labour skills – to produce its chosen outputs, given the different prices of those inputs. On the input side, there may also be potential for a wide range of indicators of allocative inefficiency, in the form of 'inappropriate' use of health system resources; for example, metrics relating to the skill mix of labour inputs can be prepared at a whole system level or a local level.

Consideration of the different levels of allocative efficiency highlights the fact that the health system may contain organizations (such as clinical teams) that are performing perfectly efficiently in producing what has been asked of them. However, consideration of a broader societal perspective may indicate that strategic decision-makers have misallocated resources between, for example, preventive and curative services, and that the efficient teams are operating within an inefficient system.

A great deal of emphasis regarding allocative efficiency has been placed on treatment guidelines and clinical pathways. Assuming guidelines have been prepared in line with the principles of cost–effectiveness, they can also be used retrospectively to explore whether provider organizations and practitioners have deviated from policy intentions and delivered what can be thought of as 'inappropriate' care. This may take the form of obviously suboptimal allocation of resources, such as hospital treatment for conditions that do not typically require such a resource-intensive setting. The wide range of metrics for treatment taking place in the wrong setting (such as emergency admissions for ambulatory care sensitive conditions or delayed discharges from hospital to a community setting) is an indication of the heightened interest in this area.

Retrospective allocative efficiency could also take the form of treatments that confer health benefits but which policy-makers have decided not to be priorities, perhaps implicitly because their cost–effectiveness ratios are above the system's chosen cost–effectiveness threshold. End-of-life cancer drugs are emerging as a particularly challenging example of such treatments in some systems, but there are many other potential metrics indicating deviation from cost-effective treatments.

Technical efficiency

In contrast, technical efficiency indicates how far the system is minimizing the use of inputs in producing its chosen outputs, regardless of the value placed on those outputs. An alternative but equivalent formulation is to say that it is maximizing its outputs given its chosen level of inputs. Any variation in performance from the highest feasible level of production is an indication of technical inefficiency, or waste. The main interest in technical efficiency is therefore in the operational performance of the entity, rather than its strategic choices about the outputs it produces or the inputs it consumes.

The analysis and measurement of technical efficiency may appear less demanding than that of allocative inefficiency. It does not require prior specification of guidelines and, instead, is usually entirely an examination of whether the outputs produced by the entity under scrutiny were maximized, given its inputs and external circumstances. Comparative performance therefore lies at the core of most analyses of technical inefficiency.

A major class of technical efficiency indicators examines the total costs of producing a specified unit of output, in the form, for example, of costs per patient within a specified disease category. The most celebrated version of such 'unit cost' indicators forms the basis for the various systems of diagnosis-related groups (DRGs), initially for use in the hospital sector in the USA [6]. These methods cluster patients into a manageable number of groups that are homogeneous with respect to medical condition and expected costs. In the first instance, a hospital's average unit cost within a DRG category can be compared with a national 'reference' cost for that DRG, often the average of unit costs across all comparable institutions [7]. This metric in itself may provide useful information on the functioning of individual specialities within the hospital.

Moreover, the number of cases in each DRG can then be multiplied by the relevant reference cost to derive the 'expected' aggregate costs of treating all the hospital's patients (if the national reference costs applied). These normative costs can be compared with *actual* costs to yield an index of the hospital's relative efficiency. This approach has usually been used in the hospital sector, but can be extended to many other units of analysis in the health system. An important barrier to applying the DRG method effectively is the great complexity of hospital cost structures. This has led to major challenges in allocating many hospital costs to specific patients and activities, and the associated variation in accounting practices is one of the reasons for the apparent variation in unit costs. Where it is feasible, greater standardization of accounting practices would seem to be an important priority.

Unit cost metrics offer insights into the overall technical efficiency of the entity (relative to other such entities), but give little operational guidance as to the reasons why such inefficiency arises, nor any insights into the allocative efficiency of the entity. Therefore, aggregate measures of technical inefficiency can usefully be augmented by more

specific metrics of operational waste, either in some specified form (such as excessive prices paid for inputs, comparatively long lengths of stay or unnecessary duplication).

Common myths about health system efficiency

The difficulties in measuring and operationalizing efficiency metrics have contributed to the promulgation of a number of myths and oversimplifications about efficiency that are not supported by evidence. These include assertions such as:

- improved efficiency is synonymous with cost containment
- improved quality of health care will necessarily lead to improved efficiency
- increased efficiency will necessarily lead to poorer health outcomes and less equitable access to care
- increased intensity of resource use (for example, increased bed occupancy) is always a sign of increased efficiency
- increased emphasis on preventive medicine will inevitably reduce health system costs and increase efficiency
- adopting methods such as DRGs for paying providers will always improve system efficiency.

To understand why these are myths, it is necessary first to understand the concept of, as well as methodological techniques used to measure, efficiency in health systems. To assist in this endeavour, in this policy brief we present and apply a framework that is designed to guide an analyst or decision-maker's approach to understanding and interpreting efficiency indicators (see Box 1).

Box 1: Methods

This narrative review of health system efficiency metrics builds on a full volume on measuring health system efficiency produced by the European Observatory on Health Systems and Policies [1], as part of the Observatory's large programme of research on performance assessment [2,3]. This policy brief provides an analytical framework for decision-makers and researchers who want to understand how health system efficiency measurements work in practice and what they really mean.

Findings

Framework

Whether inefficiency takes the form of inputs misdirected towards relatively low-value health outputs, or inputs lost in the production of valued health outputs, a first step towards remedial actions is to properly recognize the nature of any such inefficiency. It is important to be keenly aware of what a specific efficiency indicator does or does not tell you, and to be able to identify ways in which an indicator may be informative, misleading or reflect only some aspect of a production process. To this end, it is necessary to understand what is actually being measured and, importantly, how to interpret the findings from an efficiency analysis.

To facilitate this, we have developed an analytical framework showing the five aspects of any efficiency indicator that should be explicitly considered (see Figure 1). These comprise:

- the **entity** to be assessed
- the **outputs** (or outcomes) under consideration
- the **inputs** under consideration
- the **external influences** on attainment
- the **links with the rest of the health system**.

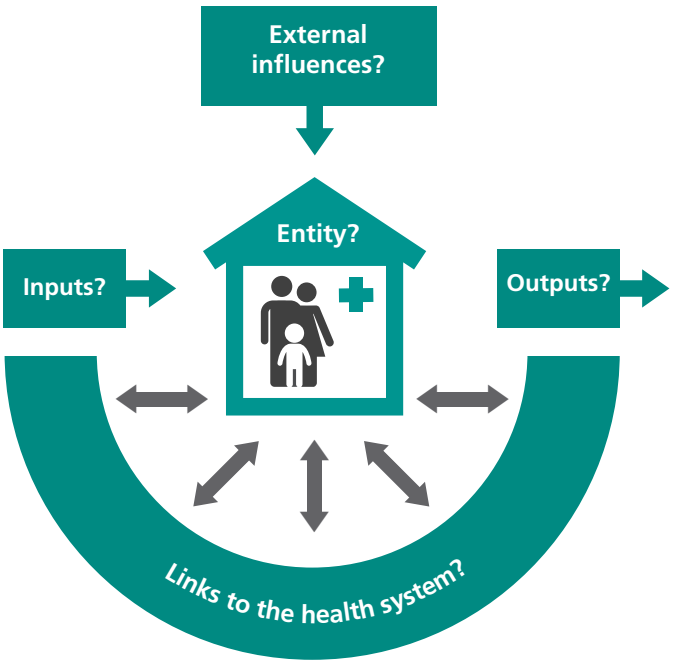


Figure 1: Visualization of analytical framework

In the following sections we discuss each of these in greater detail.

Identifying the accountable entity: what is being evaluated?

An assessment of efficiency first depends crucially on understanding the boundaries of the entity under scrutiny. At the finest level of analysis, an entity could be a single treatment, where the goal is to assess its cost relative to its expected benefit. At the other extreme, the entity could be the entire health system, defined by the World Health Organization (WHO) as 'all the activities whose primary purpose is to promote, restore or maintain health' [8].

Most often, however, efficiency measurement takes place at some intermediate level, where the actions of individuals or groups of practitioners, teams, hospitals or other organizations within the health system are assessed. Whatever the chosen level, as a general principle, it is important that any analysis reflects an entity for which clear accountability can be determined, whether it is the whole health system, a health services organization or an individual physician. Only then can the relevant agent, whether it is the government, management board or physician, be held to account for the level of performance revealed by the analysis.

Almost all efficiency analysis relies on comparisons, so it is important to ensure that the entities being compared are genuinely similar. A great deal of efficiency analysis is concerned with securing such comparability. If organizational entities are operating in different circumstances, perhaps because the population cared for or the patients being treated differ markedly, some sort of adjustment will be needed to ensure that like is being compared with like (see 'What are the external influences?' on page 11).

Almost all organizations and practitioners operate within profound operational constraints, created by the legal, professional and financial environments within which they must function. In assigning proper accountability for efficiency shortcomings, it is important to identify the real source of the weakness, which may lie beyond the control of the immediate entity under scrutiny; for example, a community nurse practising in a remote rural area may necessarily appear less efficient when assessed using a metric such as 'patient encounters per month'. However, local geography may preclude any increase and the nurse may be performing as well as can be expected within the constrained circumstances.

When choosing the entity to evaluate, there is often a difficult trade-off to be made between scrutiny of the detailed local performance of the system and scrutiny of the broader system-wide performance. In general terms, the performance of individual clinicians and clinical teams may be highly dependent on the inputs from other parts of the system; for example, the performance of the emergency department in supporting the work of a maternity unit. Furthermore, determining the resources used by local teams can be challenging from an accountancy perspective. On the other hand, moving the analysis to a more aggregate level, whilst obviating the need to identify in detail who undertakes what activity, can make it difficult to identify what is causing apparently inefficient care.

What are the outputs under consideration?

In the context of efficiency analysis in the health sector, two fundamental issues need to be considered:

1. How should the outputs of the health care sector be defined?
2. What value should be attached to them?

The consensus is that, in principle, health care outputs should properly be defined in terms of the health gains produced. However, organizations rarely collect relevant routine information about health gains and, in any case, the concept of health gain has proved challenging to make operational. In most circumstances, it is rarely possible to observe a baseline or a counterfactual (the health status that would have been secured in the absence of an intervention). Furthermore, the heterogeneity of service users, the multidimensional nature of 'health' and the intrinsic measurement difficulties add to the complexity.

Recent progress in the use of patient-reported outcome measures (PROMs) offers some prospect of making more secure comparisons, at least of providers delivering a specific treatment [9], and a number of well-established measurement instruments have been developed that could be used to collect before/after measures of treatment effects, such as the EuroQol Five Dimensions questionnaire (EQ-5D) and the Short Form-36 (SF-36) [10,11]. Although there remain many unresolved issues surrounding the precise specification and analysis of such instruments, their use should be considered whenever there are likely to be material differences in the clinical quality of different organizations.

In practice, however, analysts are often limited to examining efficiency by measuring activities; for example, in the form of patients treated, operations undertaken, or outpatients seen. Such measures are manifestly inadequate, as they fail to capture variations in the effectiveness (or quality) of the health care delivered. Yet there is often in practice no alternative to using such incomplete measures of activity in lieu of health care outcomes.

Measuring activities can also address a fundamental difficulty of outcome measurement – identifying how much of the variation in outcomes is directly attributable to the actions of the health care organization; for example, mortality after a surgical procedure is likely to be influenced by numerous factors beyond the control of the provider or even the health system. In some circumstances, such considerations can be accommodated by careful use of risk-adjustment methods. However, there is often no analytically satisfactory way of adjusting for environmental influences on outcomes, in which case analysing care activities may instead offer a more meaningful insight into organizational performance, providing there is some confidence that the activities will, in time, lead to health improvement.

What are the inputs under consideration?

The input side of efficiency metrics is usually considered to be less problematic than the output side. Physical inputs can often be measured more accurately than outputs, or can be summarized in the form of a measure of costs. However, even the specification of inputs can give rise to serious conceptual and practical difficulties.

A fundamental decision that must be taken is the level of disaggregation of inputs to be specified. At one extreme, a single measure of aggregate inputs (in the form of total costs) might be used. The input side of the efficiency ratio then effectively becomes 'costs'. This approach assumes that the organizations under scrutiny are free to deploy inputs efficiently, taking account of relative prices. In practice, some aspects of the input mix are often beyond the control of the organization, at least in the short term; for example, the stock of capital can usually be changed only in the longer term. In these circumstances, it may be important to disaggregate the inputs in order to capture the different input mixes that organizations have inherited.

Labour inputs can usually be measured with some degree of accuracy, often disaggregated by skill level. An important issue is therefore how much aggregation of labour inputs to use before pursuing an efficiency analysis. Unless there is a specific interest in the deployment of different labour types, it may be appropriate to aggregate into a single measure of labour input, weighting the various labour inputs by their relative wages. There may be little merit in disaggregation unless there is a specific interest in the relationship between efficiency and the mix of labour inputs employed. Under such circumstances, metrics using measures of labour input disaggregated by skill type may be valuable. Such analysis may yield useful policy insights into the gains to be secured from (say) substituting some types of labour for another.

Although labour inputs can be measured readily at an organizational level, problems may arise if the interest is in examining the efficiency of subunits within organizations, such as, for example, operating theatres within hospitals. As the unit of observation within the hospital becomes smaller (department, team, surgeon or patient), it becomes increasingly difficult to attribute labour inputs. Staff often work across a number of subunits but information systems cannot usually track their input across those units with any accuracy. Particular care should be exercised when developing metrics that rely heavily on input measures of self-reported allocations of professional time.

In general, capital is a key input whose misuse can be a major source of inefficiency. However, incorporating measures of capital into the efficiency analysis is challenging. This is partly because of the difficulty of measuring capital stock and partly due to problems in attributing its use to any particular activity or time period. Measures of capital are often very rudimentary and even misleading; for example, accounting measures of the depreciation of physical stock usually offer little meaningful indication of capital consumed. Indeed, in practice, analysts may have to resort to very crude measures – for example, the number of hospital beds or floor space as a proxy for physical capital. Regardless of the cost accounting method employed, it is imperative that all entities being compared use the same approach in order not to introduce unwarranted variability. Furthermore, non-physical capital inputs (such as health promotion efforts) are important capital investments that can be difficult to attribute directly to health outcomes.

As with all modelling, efficiency metrics should be developed according to the intentions of the analysis. If the interest is in narrow, short-run use of existing resources, then it may be relevant to disaggregate inputs in order to reflect the resources currently at the disposal of management. If a longer-term, less constrained analysis is required, then a single measure of 'total costs' may be a perfectly adequate indicator of the entity's physical inputs.

What are the external influences?

In many contexts, a separate class of factors affects organizational capacity – the external or 'environmental' determinants of performance. These are influences on the entity, beyond its control, that reflect the external environment within which it must operate. For example:

- Population mortality rates are heavily dependent on the demographic structure of the population under consideration and the broader social determinants of health.
- Intensity of resource use is usually highly contingent on the severity of disease.
- The costs to emergency ambulance services of satisfying service standards (such as speed of attendance) may depend on local geography and settlement patterns.
- Health outcomes achieved by clinical teams may be highly dependent on the health and social characteristics of the patient group they serve.

There is often considerable debate as to what environmental factors are considered to be 'controllable'. This will be a key issue for any scrutiny of efficiency and for holding relevant management to account. The choice of whether to adjust for such external influences is likely to be heavily dependent on the degree of autonomy enjoyed by management, as well as on whether the purpose of the analysis is short-run and tactical, or longer-run and strategic. In the short run, almost all input factors and external constraints will be fixed; in the long run, depending on the level of autonomy, many may be changeable. In many circumstances it will be appropriate to consider efficiency metrics both with and without adjustment for external factors.

Broadly speaking, environmental factors can be taken into account in efficiency analyses in three ways:

- restrict comparison only to entities operating within a similarly constrained environment
- model the constraints explicitly, using statistical methods such as regression analysis
- undertake risk adjustment to adjust the outcomes achieved to reflect the external constraints.

The first approach to accommodating environmental influences is to select only entities in similar circumstances, with the intention of comparing only like with like. But what criteria should be used to select the 'similar' entities? These might simply be readily observable characteristics (such as urban/rural location); or, statistical techniques such as cluster analysis might be used to identify similar organizations according to a larger number of observable characteristics [12].

A shortcoming of comparing only similar entities is that this will reduce the sample size as it allows comparison of performance only with similar types. A second approach is therefore to incorporate environmental factors directly into a

regression model of organizational efficiency. The regression analysis makes allowance for the uncontrollable factors at an organizational level, and the residual in the model (that which cannot be statistically explained) is the adjusted measure of efficiency. While this leads to a more general specification of the efficiency model than the clustering approach, the use of such techniques gives rise to modelling challenges that are discussed in detail elsewhere [5].

The final method to control for variation in environmental circumstances is the family of techniques known as 'risk adjustment'. These methods adjust organizational outputs for differences in circumstances before they are used in any efficiency indicator and are – where feasible – often the most sensible approach to dealing with environmental factors. In particular, they permit the analyst to adjust each output for only those factors that apply specifically to that output, rather than use environmental factors as a general adjustment for all outputs. However, risk adjustment usually has demanding data requirements, ideally in the form of information on the circumstances of individual patients [13]. The DRG adjustments described in the preceding section on outputs are one such example of risk-adjustment methods.

Links with the rest of the health system

No outputs from a health service practitioner or organization can be considered in isolation from their impact on the rest of the health system in which they operate. For example:

- the effectiveness of preventive services will affect the nature of demand for curative services
- the performance of hospital support services, such as diagnostic departments, will affect the efficiency of functional areas such as surgical services
- the actions of hospitals, for example in creating care plans for discharged patients, may have profound implications for primary care services
- the performance of rehabilitative services may have important implications for future hospital readmissions.

Likewise, cost-effective treatment is often secured only if there is effective coordination between discrete organizations. The need for such coordination is becoming increasingly important as the number of people with comorbidities and complex care needs rises. The frequent calls for better integration of patient care reflect the concern that such coordination often fails to meet expectations. That failure may in itself be an important cause of inefficiency. Failures of integration of care for patients with complex long-term needs pose an especially serious barrier to good efficiency assessment. Indeed, the very act of measuring the efficiency of separate entities may frustrate efforts to encourage cooperation between different parts of the health system unless successes of care integration are properly recognized in performance assessment. Organizations that are held to account with partial measures of efficiency that ignore coordination activities may be reluctant to divert efforts towards integration of future patient care. Linking patient data across multiple care settings is an important prerequisite for beginning to address this issue.

Scrutiny of a health system entity in isolation, be it a team of surgeons or a hospital, may ignore the important implications of its impact on whole system efficiency. For example, if a primary care practice is held to account only by metrics of costs per patient, it might secure apparently good levels of efficiency by inappropriately shifting certain costs (such as emergency cover) onto other agencies, such as hospitals or ambulance services. The chosen metric creates perverse incentives for the practice, and may fail to capture its serious negative impact on other parts of the health system. That consequence should in principle be accounted for in any assessment of that practice's efficiency. In theory, it should be feasible to accommodate such negative effects – which economists conceive as externalities – within the analytic framework. However, in practice, it is rarely done, with potentially important consequences for bias in efficiency assessment, perverse incentives and misdirected managerial responses.

Application

Assessing (and scrutinizing) common efficiency indicators

In this section we review a number of common indicators that reflect some of the stages of production where waste can occur within the health system and apply the analytical framework.

From a simplistic viewpoint, efficiency represents the ratio of the inputs an organization consumes to the valued outputs it produces. For health production processes of any complexity, there are usually a number of stages in the transformation of resources to outcomes that can be evaluated. To illustrate this, Figure 2 represents a typical (but simplified) sequence of processes associated with the treatment of acute care patients, such as those treated in a hospital, along with a set of common indicators corresponding to the production pathway. The overarching concern is cost–effectiveness, which summarizes the transformation of *expenditures* (on the left hand side) into valued health *outcomes* (the right hand side); in practice, this could be measured using the 'cost per QALY' indicator. However, the data demands of a full system cost–effectiveness analysis are often prohibitive, and the results of such endeavours may in any case not provide policy-makers with relevant information on either the causes of inefficiency or where to make improvements. In order to take remedial action, decision-makers require more detailed diagnostic indicators of discrete parts of the transformation process.

Inefficiency might occur at any stage of the production process. Take first the transformation of money into physical inputs. The principal question (given the mix of chosen inputs) is whether those inputs are purchased at minimum cost; for example, is the organization using branded rather than (presumably) less expensive generic medicines? Data on generic prescribing rates could be useful to assess this, if we assume that generic medicines are providing comparable valued outputs (in the form of health outcomes) at lower prices (Box 2). A similar question is whether the organization is paying wage rates above local market rates? A metric such

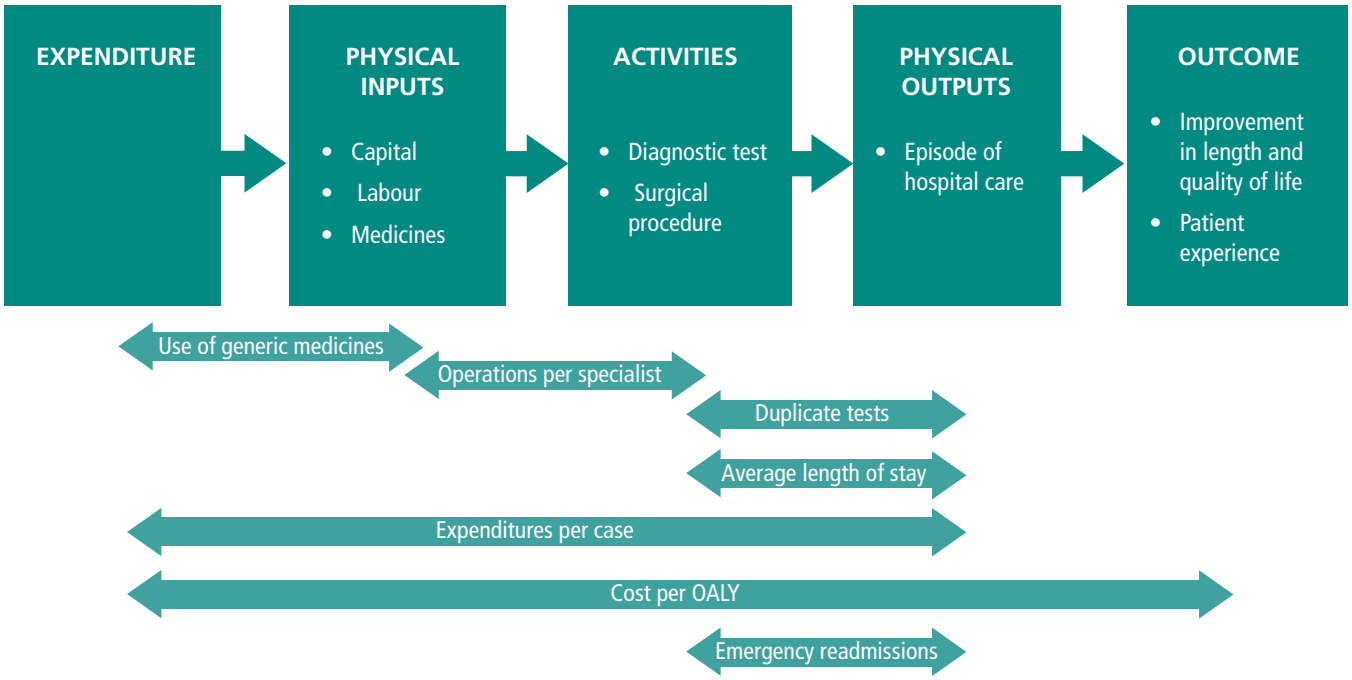


Figure 2: The production process in hospital care with common indicators along the production pathway

as average hourly wage might shed light on such issues, though it is important to adjust for skill-mix to ensure that the outputs, in the form of health care workers, are comparable across organizations. If no adjustment is made for skill-mix, the index may also capture information about the allocative efficiency of input choices: is the right mix of doctors, other professionals and administrators being deployed?

Box 2: Generic prescribing

What is it?

Measures of generic prescribing give information on whether providers and pharmacists are prescribing and dispensing generic medicines more often than brand name medicines. As generic medicines are typically less expensive than brand name drugs, if generic medicines comprise a large share of total medicines, it is indicative of greater efficiency – or more **outputs** (in this case, medicines are an output) for less **input** (cost).

What does it tell you, and what does it not tell you?

The share of generic prescribing gives an indication of whether a system is obtaining medicines at low cost. However, although this is not really a problem in European countries, it is important to be sure that generic medicines are biologically equivalent to brand name drugs; otherwise, there may be differences in the quality of drugs, which will be reflected in the **output** under consideration.

What should you do next if you find variation?

Generic prescribing is almost always a useful metric. However, if generic prescribing is low, there are various questions that must be asked to understand why. Generic prescribing may reflect **external influences** that can influence the production or consumption of generics. For example, patients may have health needs for which the most effective medicines are not yet available in generic forms, in which case, aggregate rates of generic prescribing across providers may appear low. Another example would be if patients may perceive generic drugs to be of inferior quality. If patients have expectations that generics are not equivalent to brand name drugs, it is important to either improve patient information or reduce (or eliminate) co-payments for generics while raising (or instituting) co-payments for brand name drugs.

Finally, it is important to consider **links with the health system** and how these may influence generic prescribing, such as incentives that encourage or discourage generic prescribing; for example, if providers get bonuses for prescribing brand name drugs. If pharmacists receive higher margins for dispensing brand name drugs, or if pharmaceutical companies compensate providers for prescribing brand name drugs, they may also be incentivized to offer them preferentially.

The production process now moves to the activities performed, such as diagnostic tests or surgical procedures. Possible sources of waste here may include the use of highly skilled (and therefore costly) workers for activities that could be done by less specialized workers, or using excessive hours of labour or other physical inputs in the creation of a particular activity, which may lead to a reduction in the total number of procedures that can be produced. One of countless possible indicators could be the number of operations by a specialist over a certain time frame (Box 3).

Box 3: Operations per specialist

What is it?

The metric 'operations per specialist' provides information on the number of operations any one provider is performing. The **entity** under consideration is the provider. Particularly for conditions where there is high demand, it is assumed that providers performing more operations are more efficient.

What does it tell you, and what does it not tell you?

This indicator assumes that **outputs** or activities (i.e. operations) are sufficiently comparable across providers and that **external influences**, such as the case-mix of the populations served, are also similar. However, not all operations require the same intensity of care and/or preparation time. Some operations may take longer because of different patient characteristics, resulting in fewer operations being performed overall.

The indicator also assumes that producing more operations is efficient. It does not consider other **outputs** on which the specialist may be spending time; for example, some may be involved in teaching, or supervising operations. They may be preparing for operations by reviewing case files or recommending necessary tests and/or consulting with patients. Finally, they may spend time conducting research, which can improve the efficiency of operations in the future.

Furthermore, while performing more operations may be indicative of high demand, it may also reflect supplier-induced demand. In this case, more operations would be costly and without gain, thus inefficient.

The indicator also does not consider other relevant **inputs**, such as other health care workers, and how they may contribute to operations.

What should you do next if you find variation?

If there is large variation between providers in the number of operations they are performing, it is important to understand why this is happening. Firstly, consider how the assumptions made about the **outputs, inputs and external influences** highlighted above may influence variation. It may be that the prevalence of the illness for which the operation is performed differs across the regions where the variation occurs. It may be because some of the specialists only perform the operation on a particular subset of patients, or because they are engaged in other activities. However, it is also important to explore potential sources of inefficiency related to **links with other parts of the health system**; for example, whether fewer operations are happening because of lack of operating theatre space or other clinical staff (such as anaesthetists or nurses).

Next, physical outputs are created by aggregating activities for a particular patient. In a hospital setting, this usually refers to single episodes of patient care, an aggregation of many actions such as tests, procedures, nursing care and physician consultations. There is great scope for waste in this step, for example in the form of duplicate or unnecessary diagnostic tests and similar (Box 4), or unnecessarily long length of stay (Box 5). Much depends on how the internal processes of the hospital are organized in order to maximize outputs using the given inputs. Note that the 'unit costs' metric (e.g. expenditure per case) usually links costs to physical outputs (Box 6). Numerous efficiency indicators have been developed that seek to shed some light on the reasons for variations in unit costs.

Box 4: Duplicate tests

What is it?

Duplicate testing indicators provide information on whether a particular test has been administered repeatedly to the same patient – the entity – within a short period of time. The data is often collected through patient surveys, though it can also be collected using patient records. Duplicate tests can indicate inefficient use of resources, as tests can be expensive, and if the results of a test are already known, there might not be a good reason to conduct the test again.

What does it tell you, and what does it not tell you?

While duplicate tests may be indicative of a waste of resources, this assumes that there is no benefit from conducting the same test within a certain time period; that is, that additional **inputs do not** produce more meaningful **outputs**. However, this may not always be true. For example, some tests may have high rates of false positives or false negatives, or be inconclusive; therefore, on some occasions, a provider might need to administer a second test in order to make an accurate diagnosis. Additionally, patients may require a test to be redone if enough time has passed since the previous test and there is a possibility that the results could have changed.

What should you do next if you find variation?

If patients are receiving the same tests more than once, it is important to find out where this is happening and what types of test are being repeatedly administered; for example, it may be related to other factors **in the health system**, for example if patients are receiving the same tests within a hospital because patient records are not being shared across wards. Or, it could be that patients visit different primary care providers who are unaware that the patient has already been given a particular test in another setting, again because information is not being shared. Alternatively, it could be that tests are being repeated because of the possibility the results may have changed; this should be investigated before taking action that limits access to repeat testing.

Box 5: Average length of stay for particular conditions

What is it?

As the name suggests, this measure provides information on the number of days per inpatient stay, on average. The **entity** under consideration is the hospital, where average length of stay can be used both as a general measure (to cover all conditions), and/or by particular condition/treatment (e.g. average length of stay for hip replacement).

What does it tell you, and what does it not tell you?

Average length of stay for particular conditions can help to highlight variations in resource use across providers. However, in most cases, it is not clear what the ideal average length of stay should be. It is commonly assumed that a shorter length of stay is more efficient, as a shorter stay implies reduced costs, however this may not always hold true for a number of reasons, relating to:

- Variations in **external influences**: even within the same condition, cases are different in terms of their severity and the intensity of treatment required. For example, it is likely that an older, more frail patient will need to stay in the hospital longer than a younger, healthier patient who undergoes the same treatment. It is thus likely that across hospitals there is a difference in the case-mix of the population being treated.
- The time frame being considered to measure the **output** under consideration: while shorter length of stay may seem desirable in

the short run, as it is indicative of lower resource use, it may be inefficient in the long run. For example, discharging patients early may result in an increased probability of complications or slower recovery, which can cost more in the longer term through expensive readmissions or accumulated outpatient services.

- The assumptions made about **inputs** under consideration: in its current form, the indicator assumes that every additional day in hospital expends the same resource. However, hospital costs are not the same across all days of an inpatient stay. It is likely that costs in the initial days of the stay are more expensive, as these are the days where diagnostic tests and/or interventions are more likely to occur. Later days may entail necessary bed rest and continuing medications, which will be cheaper.

What should you do next if you find variation?

If providers, or indeed countries, have different average lengths of stay for particular conditions or overall, it is important to find out which of the above explanations may apply.

Are the hospitals truly comparable? Differences in length of stay between providers may reflect differences in **external influences** such as case-mix. It is thus important to adjust for patient characteristics before concluding that longer length of stay is necessarily inefficient.

When comparing average length of stay across health systems, it may be that hospitals as **entities** are not sufficiently comparable; for example, rehabilitation is performed in hospitals in some countries, while in other countries it occurs in rehabilitation facilities. Indeed, it may also be that countries have different definitions for what they consider to be 'hospitals' and thus do not record the same information for this indicator. Comparisons should only be made between similar types of facility.

The role of **health system** factors should also be considered. For example, long-term care bed availability outside the hospital may cause variations in delays to discharge, which can influence length of stay. Longer length of stay can also reflect inefficiencies linked to administrative delays in other areas, such as delays in scheduling tests, coordinating care across providers, and/or treatment. Other structural factors related to the health system that may be important to consider are payment systems or targets. Different payment systems put in place to reimburse hospital stays, such as budgets, per-diem payments or DRGs, produce different incentives for early or late discharge; for example, hospitals who are paid on a per-diem basis can generate more income by discharging patients later than hospitals who are paid through global budgets.

Box 6: Expenditures per case

What is it?

Expenditure per case provides information on how much money is spent to deliver various health care services. Different types of health care services will require very different types and amounts of **inputs**; as a result, directly comparing the costs of a hip replacement with the costs of a hernia operation is not informative. To appropriately compare expenditures, it is important to standardize the **entity** being assessed, to ensure that we compare like with like. Two general approaches can be taken. If there is an interest in comparing aggregate expenditures, for example across hospitals, expenditures can be summed after using weights to account for differences in patient case-mix; DRGs are a useful tool to account for differences in the intensity of services. Alternatively, while less common, to compare expenditures for specific types of care, clinical vignettes that describe particular diagnoses, procedures and patient characteristics can be used to cost hypothetical episodes of care.

What does it tell you, and what does it not tell you?

Comparing expenditures gives a sense of whether too much **input** is being used to provide similar health care activities or **output**. However, countries that spend the same amount of money delivering services do not necessarily provide equivalent services. There is a question of whether the **outputs** being considered are truly comparable. It is very difficult to account for differences in the quality of care by only comparing expenditures by case, so the assumption is that the quality of care is uniform.

What should you do next if you find variation?

There are a number of reasons why expenditures per case could appear too high. It is possible that **input** costs, such as provider salaries or the prices of drugs and diagnostic tests are too high, or that too many inputs are being used to treat a condition. For example, providers may order unnecessary diagnostic tests that increase costs without additional health gains.

Likewise, the indicator relies on the assumption that the **entities** are comparable, for example that expenditures have been adjusted to render services fully comparable across systems, but this may not have been done sufficiently. It may be that health systems treat the same conditions using very different approaches, or that costs have not been properly adjusted to account for regional differences in overall prices.

Most importantly, there could be large differences in the **outputs** being compared, for example because of the quality of care provided; if a system is found to produce the same health services for much lower expenditure, it is important to ensure that patients are enjoying satisfactory health outcomes.

The final stage of the health system production process is the quality of the outputs produced. There is growing interest, particularly from a managerial perspective, in understanding how to maximize the value produced by health care [14]. Even when they employ the same physical inputs, activities or physical outputs, there is great scope for variation in effectiveness between providers. The notion of quality in health care has a number of connotations, including the clinical outcomes achieved (usually measured in terms of the gain in the length and quality of life, sometimes using QALYs) and the patient experience (Box 7). So, for example, even though two hospitals produce identical numbers of hip replacements, variations in clinical practice and competence mean the value they confer on patients (in the form of length and quality of life and the patient experience) can vary considerably. Quality-adjusted output is usually referred to as the 'outcome' of care in the literature. The quality of care has become a central concern of policy-makers, and its measurement, while contentious, is essential for a comprehensive picture of efficiency. Nevertheless, if we can agree on a measure of aggregate-valued outputs, then we are able to calculate a summary measure of 'efficiency' as the ratio of valued outputs to inputs – what is often referred to as cost–effectiveness.

Box 7: Cost per QALY

What is it?

Cost per QALY measures the cost of an additional year of good health. This measure is generally used to assess the cost–effectiveness of a particular health intervention. The **entity** under scrutiny in this case is the intervention itself. Data used to construct this measure is often from clinical trials.

What does it tell you, and what does it not tell you?

The cost per QALY indicator can be used to choose between different interventions on the basis of cost–effectiveness. On the **output** side, however, there may be factors that influence health outcomes that are not controllable by the providers. For example, adherence to the intervention or family support may influence outcomes and not be adequately factored into the analysis. On the **input** side, different providers may use different cost accounting techniques and/or different levels of resources, which may lead to variability in observed costs.

What should you do next if you find variation?

If we see variations in cost per QALY, we want to ensure that this variation is because one treatment is truly more effective than another. To ensure this we should consider that all **external influences** on outcomes are sufficiently controlled for.

It is important to note that the production of the majority of health care outputs rarely conforms to the production-line type technology implied in Figure 1, in which a set of clearly identifiable inputs is used to produce a standard type of output. Instead, the majority of health care is tailor-made to the specific needs of an individual patient, with consequent variations in clinical needs, social circumstances and personal preferences. This means that there is often considerable variation amongst patients in how inputs are consumed and outputs or outcomes are produced. For example, contributions to the care process may be made by multiple organizations and caregivers; an 'episode' of care may occur over an extended period of time and in different settings; and the responsibilities for delivery may vary from place to place and over time.

Additionally, any specific indicator of efficiency may seek to aggregate all inputs into a single measure of costs, or it may consider only a selection of inputs; for example, labour productivity measures such as 'operations per specialist' or 'patient consultations per full-time equivalent physician per month' ignore the many other inputs into the consultation and the many outputs other than patient consultations produced by the physician (Box 2). In effect, such measures create efficiency ratios using only a subset of the inputs and outputs represented by the arrows in Figure 1. Here the output measure is partial in several senses: a physician may undertake many other activities; there are many other inputs into the patient's care; and there is no information on the health gain achieved by the consultation. In short, the indicator shows only a fragment of the complete transformation of resources into desired outcomes (improved health).

This stylized example of a production pathway looks only at the hospital sector and is therefore focused mainly on hospital technical efficiency, making no judgement on broader allocative efficiency issues within the health system, such as whether patients might have been treated more cost-effectively in different settings (for example, primary care or nursing homes). Evidence of allocative inefficiencies may be seen by investigating the frequency of hospital admission for conditions that can typically be managed in less intensive settings, or even potentially from data on emergency readmissions (Box 8). Further, by focusing on the curative sector, we cannot shed light on the success or otherwise of the health system's efforts to prevent or delay the onset of disease. Similarly, the impact of the hospital's performance on other sectors within the health system is ignored. For example, it may be the case that apparently high levels of efficiency in average length of stay are being secured at the expense of heavy workloads for rehabilitative and primary care services, which may or may not be efficient from a 'whole system' perspective. To understand how efficiently an entire health system is performing, it is important to review multiple indicators covering a plethora of production pathways.

Box 8: Hospital readmission rates

What is it?

Measures of hospital readmission provide information on whether a patient has been readmitted for any cause to any hospital within a short period of time. Often this period of time is around 30 days, however in practice this can vary. This data is often reported in administrative data or patient records, and is sometimes adjusted for patient characteristics that make readmission more likely (such as patient age or known comorbidities).

What does it tell you, and what does it not tell you?

Readmission rates are used to assess the efficiency of the hospital, as readmissions may be indicative of poor-quality care received during the initial admission or of patients being discharged too early and/or receiving substandard care in hospital. If patients are readmitted to the hospital because of these factors, this additional visit can represent an inefficient use of resources.

However, readmissions may also be linked to **external factors** that are outside the hospital's control, such as other complicating illnesses, patient lifestyle and behaviours, as well as **links with other parts of the system**, such as the quality of care provided to patients after discharge.

Finally, readmissions may also be indicative of good care; if, for example, hospitals are better able to successfully treat very ill patients, and indeed save their lives, they are likely to have higher readmission rates than hospitals that have higher mortality rates.

What should you do next if you find variation?

Before coming to the conclusion that providers with high readmission rates are inefficient, it is important to rule out some of the other explanations outlined above. As a first step it may be useful to explore the causes of readmissions for particular hospitals: are they driven by particular clinical conditions or events? Do they change for particular subgroups of patients? Exploring the patient characteristics of different hospitals may also be useful and help to ensure that a population with greater health needs does not account for the higher readmission rates. This should be done even if readmission rates are adjusted for patient characteristics; for example, it is likely that a hospital in a deprived area will have different readmission rates when compared to a hospital in an affluent area, even when controlling for age and comorbidity. This may also capture **external factors**, such

as the presence of a social network after discharge or the patient's capacity for managing their own care. Exploring the proportion of patients readmitted through emergency care versus being transferred from other facilities may also help to better understand the nature of readmissions.

It may also be useful to explore the relationship between readmission rates and other measures of hospital quality to obtain greater clarity about the hospital's performance. Other **output** measures to be considered may be mortality rates or even process and throughput measures, such as patient discharge consultations, medical errors, waiting times or length of stay.

To explore variation in readmission rates across countries, it may be useful to explore additional avenues. For example, it may be useful to ensure that the **entities** being considered are comparable: Are readmissions measured in the same way and for the same time period? Are the providers and conditions included in the national definitions also consistent?

The description of a hospital production pathway above largely considers the production of outputs per inputs in isolation; that is, it reflects how well a single input (for example, in the form of costs) produces a single output (in the form of an intervention). It is nevertheless possible to combine multiple inputs and/or outputs into a single metric using methodological tools known as frontier-based methods. Data envelopment analysis (DEA) and other regression-based techniques are tools that can be used to estimate a production possibilities frontier (how much output can theoretically be produced at a given level of inputs) and assess how close a provider is to the frontier. While appearing more complex, this is essentially a simple extension of the indicators described in Figure 2. An example of frontier-based analysis comparing how well health systems produce life expectancy is described below.

Learning from system-level efficiency comparisons using frontier-based techniques

Many analyses have sought to identify the countries that claim the best overall health outcomes given their levels of health-influencing inputs, such as health expenditures, education, lifestyle and wealth [8,15–18]. Analysts can use sophisticated modelling techniques in an effort to estimate how far a country's life expectancy is attributable to a selection of these observable factors. For example, an additional year of compulsory schooling might be estimated to increase life expectancy across a range of countries by a certain amount, while an increase in alcohol consumption across the population could be found to decrease life expectancy by another amount.

Country	Accounting for alcohol and tobacco use	Accounting for alcohol, tobacco and per person health expenditure	Change in ranking after accounting for health expenditure	Appears worse after accounting for health expenditure	Appears better after accounting for health expenditure
A	1	1	0		
B	2	2	0		
C	3	3	0		
D	4	7	3	D	
E	5	4	-1		E
F	6	5	-1		F
G	7	6	-1		G
H	8	9	1	H	
I	9	11	2	I	
J	10	8	-2		J
K	11	10	-1		K
L	12	12	0		
M	13	13	0		
N	14	14	0		
O	15	16	1	O	
P	16	15	-1		P
Q	17	17	0		

Table 1. Results from exploratory efficiency analysis

Note: All models are generalized least squares with AR(1) correlation structure and heteroskedastic error structure. Models include country fixed effects which control for factors that are constant within each country across the entire sample period, and year fixed effects which account for factors which affect all countries over time. Country names are not shown.

To illustrate what frontier analysis can and cannot tell us, we use data from 1960 to 2013 from the OECD Health database and estimate our own simple models with the intention of understanding how health systems and other factors contribute to life expectancy. There is limited data available for all years, so we seek to explain variation in life expectancy using only a few variables: tobacco grams consumed per person age 15+, litres of alcohol consumed per person age 15+, and total health expenditures per person in US$ at 2005 purchasing power parity (PPP) rates. We then rank countries, where countries are more efficient if their actual life expectancy is greater than the model would predict, given the inputs selected. The results of this exploratory exercise based on data from 2010 are shown in Table 1.

In column 2, we find that after controlling for the detrimental health effects of alcohol and tobacco consumption, Country A is the most efficient at producing years of life (i.e. actual life expectancy in Country A is the longest, given what the model predicted life expectancy should be). Country Q is the least efficient in this scenario.

To evaluate the contribution of the health system to life expectancy, we next add per capita health expenditures into the model (Column 3). There are some slight changes in the rankings. Countries E, F, G, J, K and P all seem to perform better, suggesting that in these countries, health spending contributes comparatively effectively to longer life expectancy. In countries D, H, I and O, health expenditure does not contribute as many years of additional life as the model would have expected. Country A is the top performer in both models, in the sense that its actual life expectancy is the highest above that predicted by the model.

So does this mean that Country A has the most efficient health system? Based on this analysis, Country A appears to produce the longest lifespans at its given levels of inputs. But, before firmly drawing this conclusion, we need more information to understand the reasons for cross-country variations. It must be noted, for example, that Country A spends among the least amount of money per capita on health care of all OECD countries and is also among the lowest in terms of density of doctors and nurses, as well as number of beds. Country A also has comparatively high cardiovascular disease mortality and is among the highest in hospital fatality rates for acute myocardial infarction and for stroke. Cervical cancer screening, mammography and colorectal screening are all low as well [19].

Applying the framework to interpret the analysis

To better understand the results of this analysis we return to the analytical framework. The accountable **entity** being assessed here is an entire country. One important consideration is that it is not clear that all of the countries included in the analysis are comparable to such an extent that they belong to the same production possibilities frontier; that is, in all likelihood, the entities are not sufficiently comparable to be modelled together.

Moreover, the **output** considered is life expectancy, which is a rather blunt measure in that it does not reflect other health outcomes besides the population's average age of death. The main **input** of interest in the analysis is expenditure, which serves as an imperfect proxy for the health system's many inputs.

Remember that the rankings are determined by the size of the unexplained variation in life expectancy. Life expectancy is also a product of many **inputs** in addition to the three considered in this analysis. While we have attempted to control for **external influences** in the form of alcohol and tobacco consumption, there are innumerable observable and unobservable factors that we have not considered, which undoubtedly play an important role in determining population health.

Additionally, aggregate analyses such as this can provide interesting information about how well systems are performing overall and can highlight unexpected variations that might not be observed by only focusing on specific health care processes. Yet at the same time, these studies are useful only as a starting point before conducting further analysis, since they cannot give any clear indication about where problems might be occurring **within the health system** and they are susceptible to missing information. Also, the level where an efficiency issue becomes apparent is not necessarily the level where policy-makers should take action if they want to make improvements.

So what should be done next?

The analysis presented here is only intended to be illustrative. To properly conduct a comparison of health system efficiency, we would need to take different modelling approaches and take advantage of a wider range of data, while searching for repeated patterns. Any analyst running such a study should ask themselves a variety of questions before coming to any strong conclusions, such as: Are we measuring the right things? Are we using good metrics? Are we adjusting the metrics correctly? Are there other things going on that we are observing? Is our analytic model correctly specified?

In this particular analysis, Country A appears to be most efficient, partially because its health expenditure is relatively low, while life expectancy, despite being lower than in most OECD countries, is considerably greater than the approximately 70 years predicted by the full model.

The quickest way for another country to improve in the rankings would therefore be to simply reduce the level of inputs (i.e. health expenditure). Assuming that life expectancy does not change immediately, technically speaking, a country's ranking should improve. However, while this may improve a country's efficiency ranking in the short term, indiscriminately reducing health-producing inputs like health care expenditure can in the longer term lead to reductions in both allocative and technical efficiency. Highly productive parts of the health system may be affected just as much as inefficient sectors. The inefficiencies may lead to unnecessarily severe reductions in health outcomes and still worse levels of efficiency. It is important to clearly distinguish expenditure reduction and cost savings from efficiency improvement, and to note that – if required by policy-makers – any expenditure reduction should be carefully targeted to reduce the sources of allocative and technical inefficiency.

Discussion

How can health systems monitor efficiency?

In this policy brief we have reviewed common metrics that assess efficiency within and across health systems. On its own, each indicator provides only a limited amount of actionable evidence on the potential for efficiency gains. To fully grasp health system performance, one cannot rely solely on a single metric to try and assess efficiency, no matter how macro or micro that indicator is. Rather, we must 'triangulate' available information by making use of many indicators that offer glimpses into the efficiency of processes across the health system.

There is great interest in identifying the 'right' set of indicators that give the most complete snapshot of health system efficiency. However, there is no one-size-fits-all 'dashboard' of efficiency metrics. To determine the most useful metrics, it is necessary to have a clear understanding of many particular aspects of the health system. That being said, in Appendix 1, we provide a list of all indicators mentioned in this report and, using the analytic framework, we consider some of the questions analysts and decision-makers may ask themselves to understand the results, facilitate further analysis and begin to identify policy options.

The way forward

Interest in efficiency has been heightened by the apparently inexorable growth in health system expenditure in most countries, as well as the widespread belief that major improvements in efficiency can be made. However, although it is one of the most fundamental health system performance metrics for researchers and policy-makers, the concept of health system efficiency is, in practice, heavily contested and its accurate measurement across countries difficult to realize. It has proved challenging to develop robust measures of comparative efficiency that are feasible to collect or estimate, offer consistent insight into comparative health system performance and that are usable in guiding policy reforms.

Two broad types of inefficiency have been discussed – allocative and technical inefficiency. Allocative inefficiency arises when the 'wrong' mix of services is provided, given societal preferences and the limited budget available for health care (or the 'wrong' mix of inputs is used to produce services). Allocative inefficiency can occur at the level of the health system, the provider organization or the individual practitioner, and may arise from inadequate priority setting, faulty payment mechanisms, lack of clinical guidelines, weak performance reporting or simply inadequate governance of the system. Technical inefficiency arises most notably at the provider and practitioner levels, and may result from inappropriate incentives, weak or constrained management, and inadequate information. Either type of inefficiency may have profoundly adverse consequences for the patients, who are consequently given poor-quality treatment or denied treatment altogether because of the associated loss of resources.

Efficiency analysis first requires a choice of **accountable entity** to scrutinize, whether this be an individual practitioner, team, provider organization or the entire health system. Indicators of the entity's efficiency then usually represent the ratio of some **input** (or inputs) to some **output** (or outputs). We have shown that many indicators are partial, in the sense either that they seek to measure only part of the care pathway, or they capture only part of the inputs or outputs. Furthermore, to secure comparability, it is usually necessary to adjust for variations in the uncontrollable **external factors** that affect the performance of providers and practitioners, using techniques such as risk adjustment. Because of these limitations, we have argued that meaningful scrutiny of efficiency indicators must be accompanied by more in-depth analysis to ascertain the magnitude, nature and causes of any apparent inefficiency.

Clarity about the entity under scrutiny ensures that the boundaries of any analysis are clearly drawn. However, there are inevitable links between any single production process in the health system and other parts of the **health system**. The detection of inefficiency at a local level (say of a local family practitioner) does not necessarily mean that the local entity should be held responsible for that inefficiency. It will often be the case that the inefficiency arises from constraints imposed on the local organization or practitioner by higher levels of authority, for example in the form of clinical guidelines, legal requirements, performance targets or financing mechanisms. Therefore, as well as identifying the nature and magnitude of inefficiency, the analysis should also correctly identify the entity ultimately responsible for the causes of inefficiency. We therefore strongly underline the importance of seeking to 'unpack' the sources of inefficiency whenever it is found.

Scope for improving measurement

We have identified enormous scope for improvement in measuring efficiency. Conceptually, there is much work still to be done in creating indicators that conform to the usual requirements of specificity, validity, reliability, timeliness, comparability and avoidance of perverse incentives. On the input side, there is a need for more consistent and detailed costing of the care given to individual patients. Management accountants have a key role to play in this respect. On the output side, the use of PROMs might offer great scope for improved quality measurement. Furthermore, we have noted the tendency for most indicators to reflect only part of the patient pathway. The increased use of electronic health records, linked datasets and registries, capturing entire patient treatments, offers considerable scope for developing more complete efficiency metrics, capable of assessing the relative merits of alternative approaches to care.

A particularly important challenge relates to the lack of information about care outside the hospital setting. The increasing cost of meeting the complex care needs of people with multimorbidities makes resolution of this issue especially urgent. Policymakers have a clear need for better information concerning the most efficient balance of resources between hospital and community. Furthermore, there is an almost complete absence of useful evidence on efficiency in mental health care.

A general challenge to better information on efficiency is the lack of agreement on information standards and protocols. Even within countries, there is considerable variation in the interpretation of accountancy rules and the use of patient-level information systems. International comparison is even more problematic and there would be major gains if there could be international agreement on basic reporting and information standards beyond achievements such as EuroDRG and the System of Health Accounts.

A return to the efficiency myths

At the start of this policy brief we listed six statements commonly made in health policy that should not be taken as universal truths. We must emphatically underline that we are not suggesting that the search for cost-effective new innovations and reforms should be abandoned. Rather, that they should be properly evaluated, using as full an array of efficiency metrics as is practicably feasible.

Improved efficiency is synonymous with cost containment

Cost containment and improved efficiency are quite distinct. The need to contain costs may heighten the urgency of finding areas that can do 'more with less'. However, cost containment refers only to the **inputs** utilized and makes no reference to any associated changes to either the **outputs** of the entity under scrutiny or the impact of cost containment on the **rest of the health system**. Cutting costs indiscriminately may be detrimental to the volume or quality of care in some sectors and ultimately lead to worse health outcomes relative to costs. Furthermore, it may shift costs onto other health system sectors, with adverse consequences for overall system efficiency; for example, if cuts in primary care give rise to extra inefficient use of the hospital sector.

Improved quality of health care will necessarily lead to improved efficiency

This argument hinges on the belief that improved quality will lead to better health outcomes and will reduce complications, which will lead to lower health care costs for the health system as a whole. However, if securing better quality is itself costly, perhaps requiring more timely or intensive intervention, then the benefits must be weighed against these additional costs. There are no guarantees that improved quality of health care will lead to health gains and future cost reductions that are commensurate with its immediate costs. Thus, the important requirement is to match all the additional **inputs** associated with the quality improvement to the associated **outputs**, including both health gains and the **links with the rest of the health system**. If improved quality is costly in the short term, then efficiency may appear to be impaired if it is measured in terms of the cost per activity, even though it has longer-term benefits. This underlines the importance of having absolute clarity about how the **entity** under scrutiny is defined, both in terms of the scope of its activity and the time period under consideration. Too narrow a definition may fail to capture all the costs and benefits associated with increased quality.

Increased efficiency will necessarily lead to poorer health outcomes and less equitable access to care

It is sometimes argued that the pursuit of improved efficiency may be detrimental to outcomes and access. There is no reason that this must be the case. Increased efficiency frees up resources that can be used for patient care. If the improvement is in technical efficiency, then increased **outputs** can be used for the same **inputs** (or reduced inputs used for the same outputs, releasing resources for use elsewhere). If the improvement is in allocative efficiency (say between different programmes of care), then there is a need to identify carefully the appropriate **entity** under scrutiny, in this case the whole health system. With a reallocation of inputs, some programmes of care may indeed be increased at the expense of others. However, if efficiency principles are respected, the net effect will be to improve the outputs of the system as a whole, which should in this situation be the focus of attention.

Increased intensity of resource use (for example, increased bed occupancy) is always a signal of increased efficiency

Bed occupancy rates capture the extent to which available beds are being used; however, the indicator provides no information on whether beds are being used appropriately or efficiently. For example, high bed occupancy rates could reflect **external influences** on performance, such as the case-mix of patients, or an inability to discharge patients no longer needing hospital care because they have no satisfactory social care at home. Also, if bed occupancy is too high, hospitals may be unable to cope with fluctuations in demand, with serious knock-on effects for the performance of emergency services, health system costs and health outcomes. In this case, without broadening the definition of the **entity** under analysis, important **links with the rest of the health system** may be ignored. Moreover, hospital beds are only one of the many **inputs** to hospital care, so the indicator may be seriously misleading, for example, by ignoring the implications it has for the use of clinical staff. In short, without further analysis, there is no 'magic target number' that indicates the optimal use of hospital beds.

Increased emphasis on preventive medicine will inevitably reduce health system costs and increase efficiency

Preventive services are important to reduce the incidence of disease or delay its onset, and improve health outcomes. Intrinsically, they have important **links with other (curative) sectors of the health system**. They may reduce some health sector costs in the long run (e.g. an individual who takes statins is less likely to experience an expensive and traumatic cardiovascular episode). However, whether this will in fact reduce total expenditures over time is not guaranteed, given the longer life expectancy of the individuals. Furthermore, the effectiveness of preventive interventions is likely to be highly dependent on **external influences**, such as compliance with advice or medication. For preventive services, therefore, it is particularly important from an efficiency perspective that a broad definition of the

entity under scrutiny is adopted. This definition is likely to embrace the health system as a whole, considered over an extended time period, and is therefore likely to be a challenging undertaking.

Adopting methods such as DRGs for paying providers will always improve system efficiency

As a prospective method of reimbursing providers, DRGs were initially used in the Medicare program in the USA as an alternative to the manifestly wasteful 'fee-for-service' arrangements, which reimbursed providers irrespective of the effectiveness of the service. DRG payment offered a single fee for an entire episode, usually regardless of services provided, and clearly blunted the incentives for excessive wasteful care in US hospitals. However, this hospital perspective adopts a narrow view of the **entity** under analysis. For example, when introduced in other health systems that previously relied on fixed budgets for providers, DRG methods might instead stimulate additional demand for hospital care that is not necessarily cost-effective and lead to allocative inefficiency between the hospital and ambulatory sectors. Therefore, although the efficiency of the hospital sector might be improved through the introduction of DRGs, the efficiency of the system as a whole might be adversely affected.

Conclusions

The discussion of these 'myths' indicates that there is an element of truth in each of the statements. However, a scrutiny of the efficiency arguments underlying them, using the framework explained in this policy brief, indicates that in each case the policy message should be much more nuanced. In particular, any efficiency indicator associated with such statements is likely to be partial in one or more respects. There is therefore a need for careful consideration of any limitations, and we would recommend that the five-point analytical framework here sets out a useful starting point for any such analysis.

In conclusion, we would underline the central importance of efficiency metrics in governing, managing and reforming any health system. There is a massive agenda to improve the scope, comparability, timeliness, quality and usefulness of such metrics – but they should also be treated with caution. In many health systems, managers and practitioners operate within constraints that limit their scope for radical improvements, at least in the short term. There is therefore a clear need for policy-makers to set out clearly what they mean by efficiency, to give local decision-makers the leadership capacity and autonomy needed to pursue improved efficiency, and to put in place information systems that measure progress accurately and in a timely fashion.

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Appendix 1

Using the analytic framework to interpret selected efficiency measures

Efficiency measure	Accountable entity	Outputs	Inputs	External influences	Links with the rest of the health system
Antibiotic prescribing rate	Is the entity of interest a provider or an entire system?	Are patient outcomes comparatively improved due to antibiotics?	Are patients receiving antibiotics who do not need them?	Are there clinical guidelines or other factors that drive antibiotic prescribing?	What incentives exist for antibiotic prescribing? Is there evidence of high levels of antibiotic resistance infections?
Average length of stay	Are the providers/case-mix sufficiently comparable?	Are patient outcomes comparatively improved due to remaining in hospital? Is the risk of readmission reduced?	Are additional days in hospital expensive in comparison to other care settings?	Are there differences in case-mix that are not accounted for?	Can other less intensive settings treat these patients effectively? Are there capacity issues in long-term care or community care settings?
Comparison of provider expected vs actual costs	Are the providers/case-mix sufficiently comparable?	Are data available on patient outcomes?	Is cost accounting comparable across entities?	Are there differences in case-mix that are not accounted for?	Does the entity being evaluated have spillover effects on other parts of the health system? Is this entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?
Costs per patient (by condition)	Are the providers/case-mix sufficiently comparable?	Are data available on patient outcomes?	Is cost accounting comparable across entities?	Are there differences in case-mix that are not accounted for?	Does the entity being evaluated have spillover effects on other parts of the health system? Is the entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?
Cost per QALY	Is the entity of interest a particular health intervention? If so, are multiple providers involved? If the entity is a single provider, is it fully accountable for the health outcome being assessed?	Is the health outcome measure appropriate?	Is cost accounting comparable across entities? Are there inputs that affect the health outcome which are not accounted for?	Are there factors which affect the health outcome that are controllable/ uncontrollable by providers? How are these factors accounted for in the analysis?	Does the entity being evaluated have spillover effects on other parts of the health system? Is the entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?
Delayed discharges from hospital to community setting	Are the providers/case-mix sufficiently comparable?	Are patient outcomes comparatively improved due to remaining in hospital? Is the risk of readmission reduced?	Are additional days in hospital expensive in comparison to other care settings?	Are there differences in case-mix that are not accounted for?	Can other less intensive settings treat these patients effectively? Are there capacity issues in long-term care or community care settings?
Emergency admissions for ambulatory sensitive conditions	Is the entity of interest a provider or an entire system?	Are patient outcomes comparatively improved due to emergency admissions?	Can patients be seen in less intensive settings?	Are there differences in case-mix that are not accounted for?	Can other less intensive settings treat these patients effectively?
Emergency readmissions	Are providers sufficiently comparable (e.g. are they treating similar types of patients)?	Are data available on patient outcomes?	Is there information on a patient's initial admission to assess whether care was suboptimal?	Are there differences in case-mix that are not accounted for?	Does the entity being evaluated have spillover effects on other parts of the health system? Is the entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?

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Efficiency measure	Accountable entity	Outputs	Inputs	External influences	Links with the rest of the health system
Expenditure per case	Are cases sufficiently comparable?	Are data available on patient outcomes?	Is cost accounting comparable across entities?	Are there differences in case-mix that are not accounted for?	Does the entity being evaluated have spillover effects on other parts of the health system? Is the entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?
Excessive referrals to specialists	Is the entity of interest a provider or an entire system?	Are patient outcomes comparatively improved due to specialist referrals?	Can patients be seen in less intensive settings?	Are there differences in case-mix that are not accounted for?	What incentives exist for primary care providers to refer patients?
Frontier analysis (e.g. DEA)	Are the entities sufficiently comparable (i.e. do they belong to the same production possibilities frontier)?	Are the outputs produced entirely by the inputs? Is there information on health outcomes?	Do the inputs fully account for the outputs?	Are there factors which affect the outputs that are controllable/ uncontrollable by the entities? How are these factors accounted for in the analysis?	Does the entity being evaluated have spillover effects on other parts of the health system? Is the entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?
Generic prescribing rates	Are the providers/case-mix sufficiently comparable?	Are generic medicines of comparable quality?	Are generic medicines less expensive than branded?	Are there factors (such as economic interests) which affect the production or consumption of medicines?	What provider incentives exist for generic prescribing?
Operations per specialist	Are the providers/case-mix sufficiently comparable?	What other outputs besides operations is the specialist spending time on?	Are there inputs not accounted for (e.g. other health workers participating in an operation)?	Are there differences in case-mix that are not accounted for?	Does the entity being evaluated have spillover effects on other parts of the health system? Is the entity dependent on coordination across multiple providers (or, alternatively, can it shift some of its costs to other providers)?
Prices paid for inputs (e.g. average hourly wage)	Are prices adjusted sufficiently to account for variability in cost-of-living across entities?	Are the inputs (e.g. labour, capital) comparable in terms of quality?	Is cost accounting comparable across entities?	Are there factors which affect the prices of inputs broadly (e.g. factors affecting wages for other sectors)?	Are prices fixed (e.g. public-sector salary scales)?
Skill-mix of health workers	Is the entity able to alter its mix of health workers?	Does the mix of health workers reflect population needs?	Are wages for health workers appropriate given their skill level?	Are there factors (such as migration, education) which affect the skill-mix of health workers?	If the entity is a system, to what extent are there variations among providers?
Unnecessary duplication of an activity (e.g. diagnostic tests)	Is the entity (e.g. provider or a system) aware of duplicate activities by other entities?	Is data available on patient outcomes?	Is a duplicate activity definitely not necessary (e.g. has sufficient time passed since a prior test or is there a high likelihood of false positives?)	Are there differences in case-mix that are not accounted	Are there issues related to sharing of patient information? Are there incentives for over-utilization of services?

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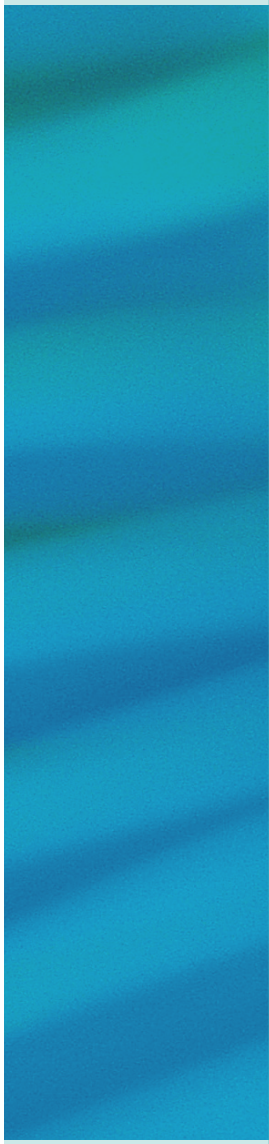

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