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Scoping Exercise: Patient Flow Management and Metrics in Public Hospitals in Mexico

Final Report to Metrics for Management

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Acronyms and Abbreviations

ALOS	Average Length of Stay
ED	Emergency Department
GH	General Hospital
GYNOB	Gynecology and Obstetrics
ICU	Intensive Care Unit
IW	Inpatient Ward
MCH	Maternal-Child Hospital
OP	Out Patient
OR	Operating Room
PACU	Post-Anesthesia Care Unit
PF	Patient Flows
PFA	Patient Flow Analysis
PFMPs	Patient Flow Management Practices
PHC	Primary Health Care
PPP	Public-Private Partnership

I. Introduction

Analyzing and improving patient flow management practices (PFMPs) has become a key component of performance improvement efforts in hospitals and health systems in high-income countries. This has not been the case in developing countries, where PFMPs applications are scarce. PFMPs consist of a set of valuable (and proven) tools for hospitals and delivery systems to improve quality of care, patient experience, staff productivity and outcomes while containing costs. For example, analysis of PFMPs can help facilities with the following:

- Assess their processes and effectiveness in delivering services to patients in emergency departments, operating theaters and wards;
- Promote collaboration and team building by fostering greater coordination across hospital departments and with ambulatory providers located in hospital catchment areas; and
- Craft metrics that encourage an understanding of data and its relevance to running the hospital and engaging with other providers.

Analytical inputs are critical to shaping patient flow improvement interventions, monitoring their effects on patient flows, and measuring their impacts in terms of benefits to financial, quality and patient outcomes. Measuring and improving PFMPs has the additional value of transforming heretofore "data producing" organizations into "information-driven" organizations that utilize evidence to inform decision-making and improve performance and outcomes.

A patient flow assessment lays the foundation to identify problems within hospitals related to how patients are admitted, discharged and transferred among units and to other hospitals and how care is coordinated with ambulatory providers, as well as to develop strategies to address these problems. In an ideal world, only patients requiring complex care would access the hospital, and the hospital would shepherd them through the various administrative and service delivery points—registration, screening, diagnostics, admission, treatment and discharge—in a timely but steady manner. In other words, all patients would receive the right care at the right time, in the right place. However, the world is rarely ideal. While patient arrival patterns can vary enormously and contribute to flow bottlenecks, research has shown that suboptimal internal processes for managing the peaks and valleys of patient flows are also to blame, resulting in delays, cancellations, patient misplacement, lower quality care (e.g. increased medical errors) and, ultimately, undesirable outcomes (Litvak and Fineburg, 2013; Baker et al., 2009).

This report presents the findings of a scoping exercise or rapid assessment of patient flow management practices and metrics in low-resource hospital settings based on a sample of public hospitals in Mexico. Drawing on the literature from hospitals in high-income countries, Section 2 first provides a brief overview of the benefits of good patient flow management practices. Section 3 states the objectives and research questions guiding the scoping exercise. Section 4 reviews the sampling framework and methods. Sections 5, 6 and 7 report the findings, namely the manifestations, impacts, and causes, respectively, of patient flow mismanagement. Notably, while the findings are numerous and diverse, there is considerable consistency across the sample hospitals in terms of flow problems, their impacts and underlying causes. Section 8 reviews data issues and opportunities for developing feasible patient flow metrics. Section 9 concludes the report by outlining relevant patient flow metrics for a proposed second phase of work.

A set of annexes containing supplementary information and instruments used in the scoping exercise accompanies this report as a separate document. Annex 1 briefly reviews the existing

literature on the benefits of patient flow improvements, drawing on examples from high-income countries. Annex 2 provides basic summary information and data from the sampled hospitals. The instruments used by the investigative team during hospital visits to guide focus group interviews and facilitate the collection of standardized information are provided in Annexes 3 and 4, respectively.

II. Background: Why Patient Flow Management and Metrics Matter?

Patient flow analysis (PFA) involves measuring and understanding where problems in patient flows exist in health care settings, including their causes and impacts. Successful PFA provides the inputs necessary to formulate and implement effective strategies, front-line management practices and metrics for patient flow improvement, with the goal of using existing resources more effectively and in a timelier manner to achieve higher quality care, greater efficiency and better patient experience. Research from hospitals in high-income countries shows that these gains can be made by streamlining patient flows and redesigning care practices without adding more infrastructure or staff. Annex 1 provides a summary of the literature on the benefits of improved patient flow management, highlighting the following major improvements for hospitals:

- Added capacity without capital expense**:** Through shorter lengths of stay in emergency departments and wards and better time management of operating rooms.
- Better clinical outcomes**:** By improving timeliness of care and standardizing processes, better matching patients to the appropriate level of nursing care, diagnostics, specialists, and treatments, and enhancing post-discharge coordination with primary care providers.
- Better patient experience and facility reputation**:** By reducing wait times, patient flight and periods in which patients are left unattended.
- Improved staff productivity**:** By reducing paperwork, streamlining processes and enhancing communication among staff.
- Reduced costs**:** Through higher patient throughput, elimination of waste and avoided expensive capital investments.

III. Objectives and Research Questions

The objectives of the scoping exercise included: (i) identify the major patient flow problems (and their root causes) in public hospitals that make hospitals less effective in terms of timeliness, efficiency and quality of care; (ii) determine how patient flows are currently measured; (iii) identify opportunities and obstacles, including available data and metrics, to measuring and addressing patient flow challenges in low-resource settings; and (iv) determine the demand for better metrics and improved patient flow management amongst key stakeholders, including government officials, hospital directors and staff.

The assessment examined three patient flow dimensions:

(i) Intra-hospital: The exercise focused primarily on internal hospital flows. The team examined PFMPs in emergency departments (ED), operating rooms (ORs) and inpatient wards (IWs) and, to a lesser extent, in intensive care units (ICUs), post-anesthesia care units (PACUs) and outpatient departments (OPs).
(ii) Inter-hospital: This dimension encompasses patient transfers between hospitals.

(iii) Linkages between hospitals and primary care providers: This dimension includes referral and counter-referral systems, post-discharge care and broader care coordination practices across provider levels.

The results of the investigation will inform what needs to be done on the ground to pave the way for a subsequent effort in Mexico to improve the measurement of patient flows and develop managerial strategies and interventions to improve patient flow practices. To this end, a complementary product to this report is a proposal to fund the development and implementation of effective patient flow management practices and corresponding metrics in low-resource settings in Mexico, and elsewhere.[1] Investigative questions guiding the scoping exercise are as follows:

Primary Questions: What are the major patient flow issues and bottlenecks facing public hospitals? What are rigorous yet feasible metrics in the public hospital context that can help facility managers diagnose, measure, understand and address the identified problems?

Secondary Questions: Are there sufficient incentives and demand for hospital managers and staff to improve patient flows? How can patient flow metrics be measured in an effective yet affordable way?

IV. Sample, Approach and Methodology

The scoping exercise included nine state-operated hospitals in four states.[2] Annex 2 presents summary characteristics of the nine facilities. All were secondary level hospitals consisting of two types: five "general hospitals" offering care in specialties such as general surgery, internal medicine, pediatrics, gynecology and obstetrics (GYNOB); and four maternal-child hospitals offering pediatrics, GYNOB and neonatology. Some hospitals offered additional specialties. Facility size ranged from 85 to 232 beds and all hospitals were located in urban or peri-urban areas, usually secondary cities, but served as referral facilities for catchment areas consisting of both urban and rural populations.

Typical of state-operated facilities in Mexico, nearly all hospitals in the sample were directly administered and supervised by the State Health Secretariat. Hospital managers had limited autonomy in budget and resource management, including staff and supplies, and all resources were procured and managed centrally. One general hospital, however, was managed under a public-private partnership (PPP) arrangement in which staff was contracted through a third party, but managed by facility directors, who were civil servants. While the management team in this hospital exercised considerable autonomy in human resource management, drugs, supplies and equipment were procured through the State Health Secretariat. Because of a special governance arrangement, another hospital had full autonomy in human resource management.

Most of the hospitals outsourced maintenance, and, to a lesser extent, specialty diagnostics and other high technology services to third parties. All of the facilities served low-income populations affiliated with the federal government's health insurance program known as *Seguro Popular*, which

[1] See accompanying proposal: "Improving patient flows in Mexican hospitals through metric development and management interventions."
[2] States were selected with the support of former officials of the Federal Health Secretariat and specific hospitals were chosen by State Health Secretaries. In general, the sample consisted of hospitals that state officials deemed to suffer from overcrowding and were easily accessible by ground transportation (within two hours of the offices of the State Secretariat). By mutual agreement with state officials, the names of states and sampled facilities remain anonymous.

primarily channeled payments through State Health Secretariats, which in turn incorporated them into hospital budgets. However, most hospitals received direct payments from *Seguro Popular* for specific "catastrophic" procedures and treatments for which they had been previously accredited by the insurance program.

The investigative team employed a four-pronged approach to assess patient flows:[3] [4]

(i) Focus groups of two to three hours with hospital managers and staff, usually consisting of the medical director or sub-director, nursing director, departmental directors and head nurses from the emergency department, operating theatre and wards. In most cases, front-line physicians and nurses were present. The team followed an open-ended questionnaire to guide the discussion (see Annex 3).
(ii) Hospital tours to observe overcrowding and bottlenecks, which included short conversations with front-line staff on patient flows through service areas.
(iii) Application of a checklist survey instrument completed with groups of managers and staff from specific departments: ED, OR, outpatient clinics, ICU and IWs (see Annex 4).
(iv) In-depth assessment in one hospital that involved examining and collecting data from registries, information systems and statistical reports.[5] Given the unitary nature of the public hospital system in Mexico, nearly all hospitals have similar time logs, patient registries, information systems, and statistical reports, suggesting that similar assessments could be carried out at other facilities. The team also mapped out flows in specific departments and documented administrative procedures for certain processes (such as admissions and discharges).

V. Manifestations

This is the first of three sections reporting on the findings. It summarizes the manifestations of patient flow problems in specific departments, inter-hospital transfers and linkages with primary care facilities. Where relevant, data are provided to support the findings from the focus groups. Figures 1-4 display the manifestations of patient flow problems in the ED, OR, IW and ICU/PACU for the sample hospitals as reported by hospital managers and staff working in these departments.[6] [7] Figure 5 depicts patient flows in the ED of one hospital. Figure 6 displays estimates of unnecessary patient flows to all hospitals (i.e. low acuity patients who can be treated at lower care levels). Most of the manifestations indicated in the figures were reported by at least half of the hospitals; generally, EDs and ORs experienced a higher incidence and frequency of patient flow challenges.

[3] The research team also met with state secretaries of health to discuss the objectives of the scoping exercise. In one state, however, the position of health secretary was vacant, so the team met with the former state health secretary.
[4] The team completed the scoping in a single visit to each facility lasting three to four hours.
[5] The in-depth assessment required two visits totaling about 10 hours in the hospital.
[6] It is important to note that these issues are similar to those observed in the literature of hospitals located in high-income countries (Litvak, 2010; Sayah et al., 2016; Michtalik et al., 2013; White et al., 2014).
[7] The hospitals were coded by type: GH stands for general hospital and MCH for maternal-child hospital.

Figure 1: Number of Public Hospitals Reporting PF Problems in ED (N=9)

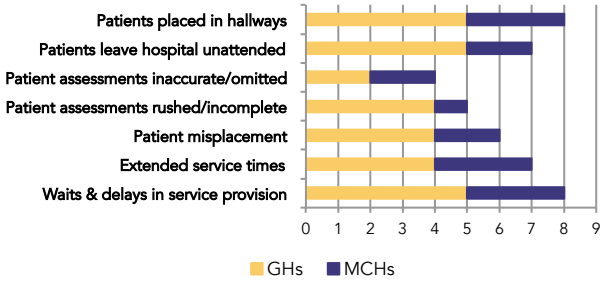


Figure 2: Number of Public Hospitals Reporting PF Problems in OR (N=9)

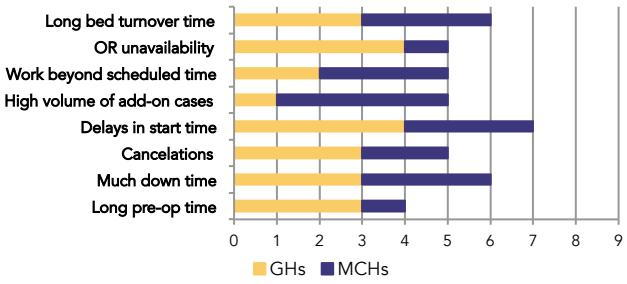


Figure 3: Number of Public Hospitals Reporting PF Problems in Wards (N=9)

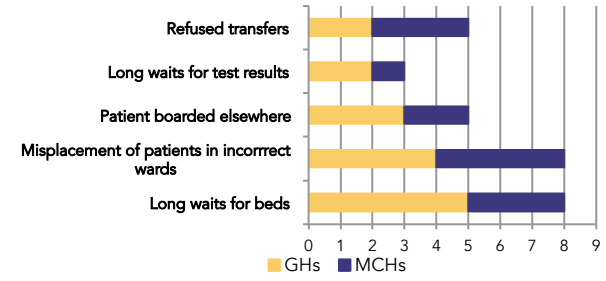
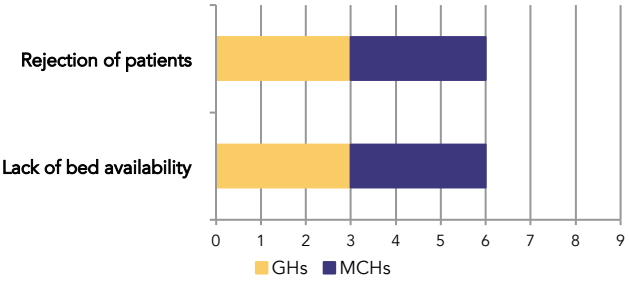


Figure 4: Number of Public Hospitals Reporting PF Problems in ICU/PACU (N=9)



Emergency (ED): All hospital EDs in the sample applied a triage system by which arriving patients are classified, usually by nurses or residents, into one of three severity groups: (i) critical or high severity ("code red" patients) in need of urgent care; these are immediately routed into the ED; (ii) serious or moderate severity ("code yellow" patients) requiring more or less immediate care but without a life-threatening condition; depending on the hospital, these patients are directed into ED observation or waiting rooms, but receive care promptly, usually within 30 minutes; and (iii) low severity ("code green" patients), not requiring immediate attention. These patients represent the vast majority of ED arrivals in all hospitals and often arrive in great volumes in the morning. They are given a queue number and directed to waiting rooms or outside waiting areas to remain until called for a consultation, which can take hours. In some facilities, a subset of code green patients may be sent to the OP for a consultation. Physicians, supported by the nursing corps, provide all ED consultations. Figure 5 maps the triage system and ED patient flows of one hospital.

Code red and yellow patients are frequently placed on gurneys in hallways for treatment and observation during peak utilization periods and long queues form at different service points across the ED (see Box 1). Some hospitals have converted consultations rooms and waiting rooms into boarding areas where overflow patients are held for many hours, if not overnight, until an ED (or more likely IW) bed becomes available. In one hospital, the team observed two crowded overflow

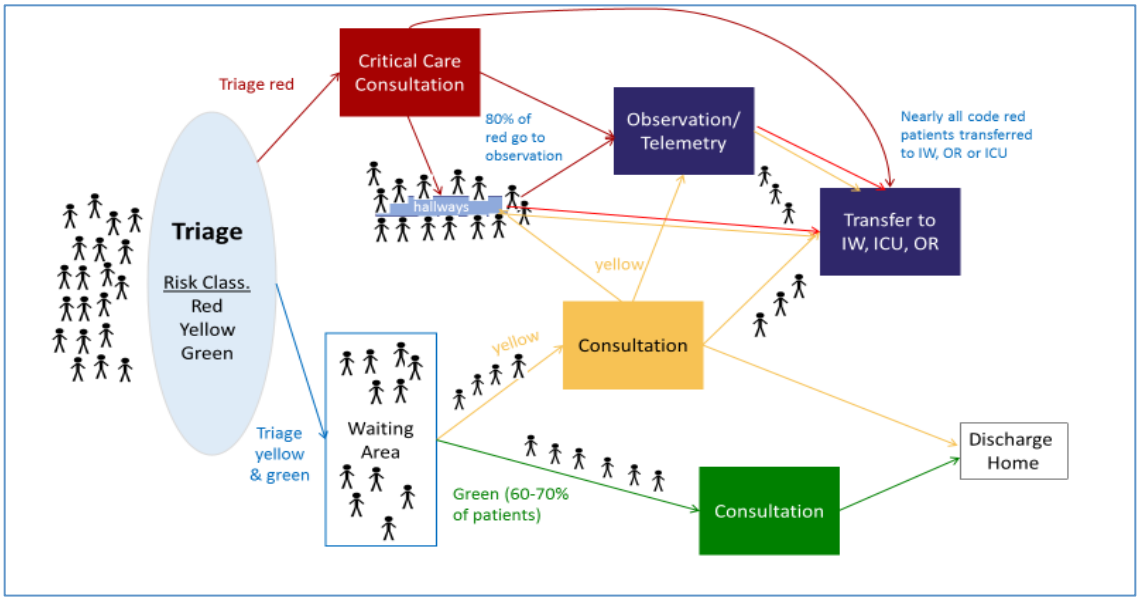
Box 1: Extended length of stay in the ED

Reported average length of stay (ALOS) in the ED can be deceiving. One hospital reported an average wait of 5.5 hours between admission to ED and securing a bed in the IW, but the distribution revealed a number of cases in which patients waited between 10 and 60 hours. In another facility, it was not unusual for patients' ED LOS to exceed 15 days, in part due to unavailability of IW beds. While clinical staff attended to these patients during these periods, the congestion and long waits resulted in suboptimal care.

rooms (for code yellow patients) in which patients had to sit up in chairs for up to 36 hours, usually waiting for an ED or IW bed. Patient misplacement, or placement in an inappropriate holding or boarding areas, is common.

Periods of high overcrowding place enormous pressure on clinical staff, especially nurses, to simultaneously attend large numbers of patients, some of whom are in critical condition. As shown in Figure 1, hospitals reported that patients can be left unattended for undetermined periods in hallways and boarding areas and that the "super saturation" can result in rushed, delayed, incomplete or inaccurate assessments and diagnoses, including failure to follow established treatment protocols. In most hospitals, delays in ordering and performing diagnostic tests, as well as in receiving the results also contribute to the treatment delays.

Figure 5: Triage System and ED Patient Flows



Operating Room (OR): Most hospitals reported significant bottlenecks in the OR (see Figure 2). In terms of patient flows, ORs can best be described as intermediate units whose efficient (or inefficient) use invariably impacts patient flows in other departments: OR patients originate from ED and surgical IWs (pre-surgery) and after surgery are transferred to PACUs, ICUs and IWs. OR bottlenecks contribute to patient backups and long waiting times in the ED and also compromise planning and use of beds in PACUs, ICUs and surgical IWs.

ORs have two work streams: scheduled and unscheduled surgeries. The former consists of elective and non-elective procedures that are programmed in advance, while the latter is made up of emergency cases (e.g. code red or yellow patients). These cases are typically added to scheduled procedure loads, resulting in delays, bumping and rescheduling of scheduled procedures.[8] Queues for elective surgeries may be weeks or months. In several hospitals, the full stock of ORs was not

[8] In one hospital, the ratio of scheduled to unscheduled surgeries was approximately 1:3.

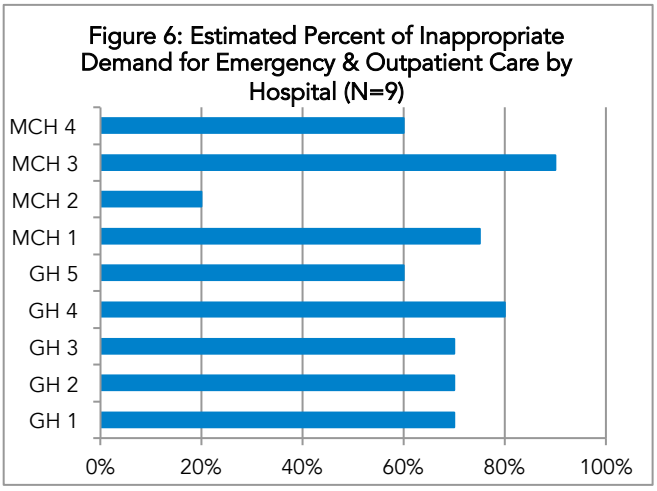
operational or only available on a part-time basis, usually due to human resource limitations related to scheduling arrangements.
Several hospitals reported an apparently paradoxical situation of low OR productivity and long periods of OR downtime combined with regular cancellations of scheduled procedures and extended work hours, suggesting artificially-generated patient flow bottlenecks or poor programming of OR time. The latter may be driven by reportedly long OR turnover times (time between procedures) caused by delays in OR cleaning, long pre-operation preparation and delays in start times for scheduled surgeries.

Inpatient Wards (IWs), Intensive Care Units (ICUs) and Post-Anesthesia Care Units (PACUs):
Hospitals reported patient flow challenges related to matching demand to available bed supply in IWs (see Figure 3). Allocation of beds to specialties may not match demand, meaning some wards are saturated with patients while beds go unutilized in others. Nearly all hospitals reported long waits for beds and boarding of patients elsewhere, often in inappropriate wards or rooms (e.g. surgical patients placed in internal medicine wards). Lack of available beds often results in refused transfers from the ED, creating backups and long waits.

Patient flows in ICUs and PACUs appeared to be less of an issue (see Figure 4). While hospitals reported some patient rejection and lack of bed availability in these units, patients requiring intensive care may be temporarily boarded in the PACU or a telemetry unit to help alleviate congestion.

Intra-hospital transfers: All state-operated hospitals in Mexico are safety net facilities and follow a "zero rejection" government policy that mandates they cannot refuse any patient, including patients insured by the various social security systems in Mexico. Most are also referral facilities for the public network in their jurisdictions. While most hospitals have agreements governing transfer arrangements with other hospitals, they are usually not applied and transfers depend mostly on personal relationships across hospital and departmental directors. Nevertheless, hospital managers did not identify transfers as a major issue, though a subset of hospitals did mention that private and public facilities sometimes dump (usually critical) patients without advising the receiving hospital first.

Linkages between hospitals and primary care units:
All hospitals operate within a specified jurisdiction and serve as referral facilities for an extensive network of primary care (PHC) units, and to a lesser extent, small rural hospitals. Formal linkages between hospitals and these units appear weak. All sample hospitals identified patients with non-acute conditions not requiring hospital-based care as a major patient flow challenge. As Figure 6 shows, most hospitals estimated that between 60 and 90 percent of patients seeking care in the ED and OP have relatively simple conditions that could (and should) be resolved at the



primary care level. Hospitals maintain that catering to these patients—who represent the majority of ED arrivals and OP appointment seekers—is a main contributor to overcrowding; furthermore, they divert scarce resources away from the severely ill and patients with complex conditions.

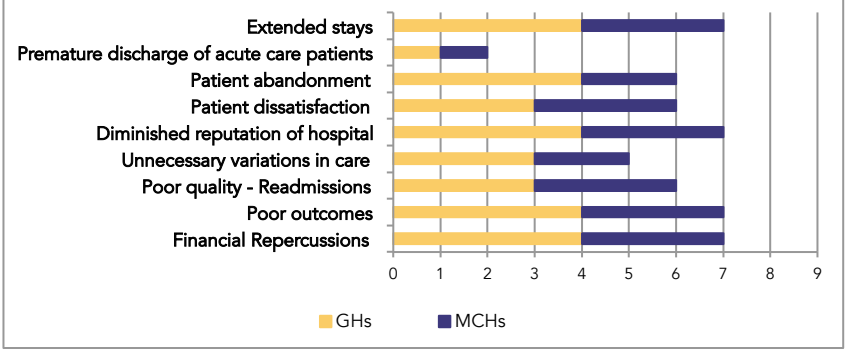
The referral and counter-referral system also appears dysfunctional. Hospitals mentioned that PHC facilities ignore existing patient referral guidelines, instead referring patients unnecessarily and for conditions that are inappropriate for hospital care and best treated at a lower level. Hospitals are not blameless, however: upon patient discharge, hospitals send medical records and care guidelines to the patient's PHC unit, but rarely follow-up to confirm whether the unit received the documentation, understood the instructions and were providing appropriate care.

VI. Impacts

Highly congested systems create a hectic, stressful environment for both patients and staff, compromising quality of care and patient safety and increasing costs and the risk of adverse outcomes. In the ED, for example, boarding of patients—usually in suboptimal settings—can cause treatment delays and breaches in the application of standards and protocols (such as timely medication administration and pain monitoring, turning of patients, etc.). For example, as the ED nursing corps scrambles to attend a steady flow of new arrivals, some patients may simply be left unattended, contributing to deterioration in their condition.

As observed in hospitals in high-income countries, the sample hospitals reported that staff overloading (e.g. unsafe workloads) has resulted in medical errors and suboptimal outcomes, in turn contributing to longer stays, readmissions, unnecessary variations in care, and, in some facilities, higher mortality (see Figure 7). Long waiting times also resulted in patient dissatisfaction and flight. Most hospitals reported that "voluntary discharges" (patient leaving the facility against medical advice or before treatment is provided or concluded) were a serious issue. For example, one hospital tallied an average of 41 and 8 voluntary discharges per month from ED and IWs, respectively.[9] The hospital also reported that on average 15 patients per month abandon the ED after registration without receiving care.[10]

Figure 7: Number of Public Hospitals Reporting Negative Effects of PF (N=9)



[9] According to state policy, a voluntary discharge is registered because the patient must sign a form and hospitals are required to report the number.
[10] These are usually "code green" patients.

According to hospital officials and state authorities, congested conditions, lack of privacy, long waits for care or securing a bed, surgical cancellations and extended lengths of stay compromise the reputation of hospitals, and the public delivery system in general. Some facilities also emphasized staff burnout and dissatisfaction due to heavy workloads resulting in low morale, staff turnover (e.g. ED nurses) and lower levels of effort. Finally, patient flow inefficiencies contribute to higher costs (e.g. readmissions, longer than necessary lengths of stays, surgical cancellations, extended hours) and lost revenues (e.g. patient flight).[11]

VII. Causes

What reasons did hospital managers and staff give for the patient flow problems and delays detailed above? Not unexpectedly, most hospital directors first identified inadequate capacity, such as infrastructure limitations[12] and staff shortages, as the main cause of patient flow problems. However, acknowledging that fiscal constraints would make it highly unlikely for state governments to invest in hospital expansion or enhance human resource budgets in the foreseeable future, upon further probing directors identified a number of shortcomings in patient flow management practices.

All of the hospitals experienced significant variations in patient demand volumes: fluctuations depended on the time of day and day of the week. As suggested above, the same hospital may experience overcrowding and congestion on certain days and times, and under-utilization and down time on others. Some high-volume demand was predictable and contributed to long queues and congestion (e.g. early morning weekday demand for ED and OP), but other bottlenecks appeared artificial or non-random and even self-inflicted. For example, hospital staff identified the following practices that could negatively impact patient flows and extend wait times and lengths of stay:

(i) Ordering, administering and receiving results of diagnostic tests,
(ii) Processing the paperwork for IW admissions and discharges,
(iii) Arranging intra-hospital consultations by specialists,
(iv) Delays in IW bed turnover time (between a discharge and new admission) and OR turnover time (between surgeries),
(v) No standardized process for inter-departmental patient transfers,
(vii) Improvised bed management in IWs.[13]

Other administrative causes included poor scheduling of programmed surgeries in ORs and elective admissions in IWs. For example, surgeons scheduled programmed surgeries according to their assigned block time, which corresponded to their preferred availability rather than optimal throughput. Late arrivals of surgeons or patients and inefficient pre-operative care processes can also create flow problems by delaying start times, leading to backups and cancellations later in the

[11] All of the hospitals received direct payments from *Seguro Popular* for one or more "catastrophic" conditions. While these payments represent a minor portion of the hospitals' budget, they are important to their overall financial viability.
[12] All but one of the facilities were constructed or remodeled during the last 10 to 20 years.
[13] For a 200-bed hospital, one extra LOS day reduces bed availability by 33 beds/month.

day. Poor planning of OR time resulted in emergency surgeries "bumping" programmed surgeries, causing delays and cancellations. In wards, lack of IW bed management and planning practices contributed to extended stays and bed unavailability which in turn contributed to refused transfers, "off-service" boarding and long bed waiting times in the ED.

Another cause highlighted by hospital and departmental directors is rigidities in staff management that restricted managers from addressing peaks in demand volume. All staff were assigned to a specific shift and service area and collective union agreements disallowed reallocating staff across shifts. Within a shift, management could redistribute staff across service areas (e.g. from the IWs to the ED) on a temporary basis, but only if the staff member agreed. Some hospital directors claimed that their hospital had sufficient staff, but they were poorly distributed across shifts and service areas. They stated that their "hands were tied" by the collective agreements, however, preventing them from redistributing staff to match demand. Several directors also cited low productivity of some staff as a contributor to low throughput.

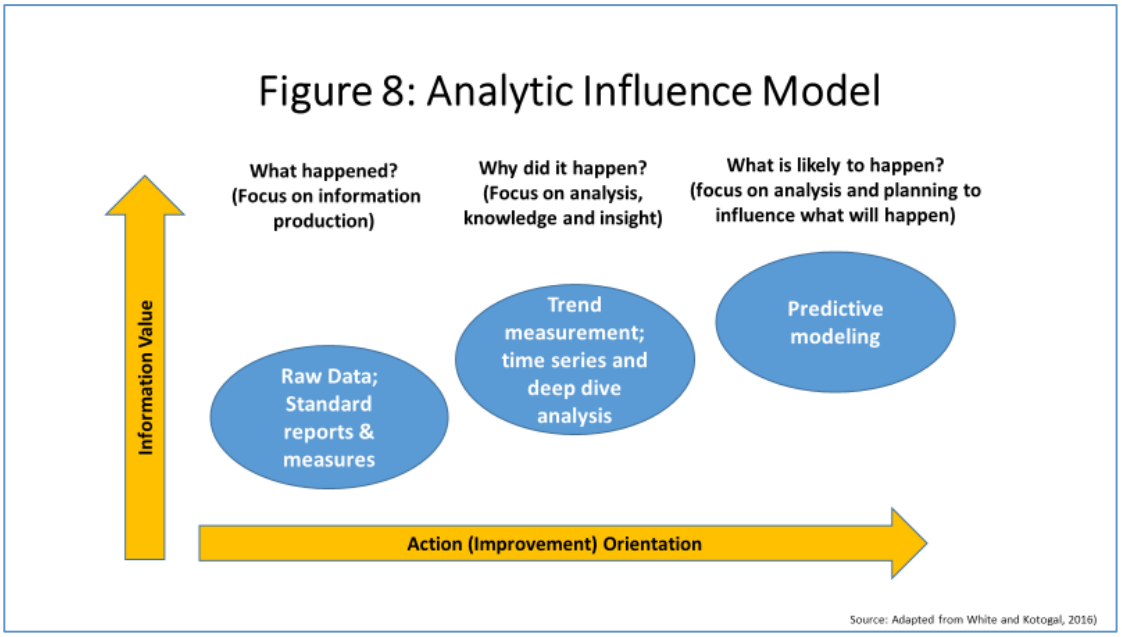
As previously mentioned, all hospitals complained of the failure of primary care facilities and the referral system to mitigate demand for avoidable hospital care (e.g. for low-acuity conditions that can be appropriately treated at PHC facilities). Hospital staff cited multiple reasons for this situation, including: limited consultation hours and appointment slots at PHC facilities, leading to long wait times with no guarantee of a physician consultation; PHC facilities were staffed by medical students or recent medical school graduates with limited clinical experience and little familiarity with referral norms; high turnover of PHC physicians; restrictions in the use of drugs at PHC facilities; and lack of focus on chronic conditions. With a few exceptions, most hospitals have done little to work with PHC providers to rectify the situation, in part because PHC facilities and hospitals are overseen by separate and vertically-managed directorships in State Health Secretariats and coordination between these entities is often lacking.

VIII. Data Issues and Opportunities

Given that patient flows are not on policy or hospital performance agendas, hospital information systems do not capture data specifically for monitoring and improving patient flow management. Therefore, most of the sample hospitals did not maintain a set of metrics that could provide evidence or insights on facility-specific patient flow problems and their causes. Nevertheless, the hospitals did carry out relatively wide-ranging and regular data collection through information systems and registers. Informative analysis and presentation of hospitals' own data would be a fast and relatively feasible way to assess patient flow issues, inform corrective measures and gain support from managers and staff to improve patient flow patterns.

One way to frame the current data and metric situation is to examine the hospitals in terms of the Analytic Influence Model displayed in Figure 8. This model gauges organizations in terms of how data and analytics are used to influence change and inform improvement. The sampled facilities are currently at the lower end of the continuum: they tend to produce information on 'what happened' and 'what is happening' for standard monitoring and reporting. Addressing patient flow issues will require shifting the information culture upward, however, toward producing information of higher value to inform actions to improve performance. The first step will involve developing metrics based on time series, trend and in-depth analytics to gain insight and knowledge into patterns and

causes of patient flow failures ('why it happened'). A future step will be to use the same time series, trend and monitoring data (and metrics) to provide guidance on 'what is likely to happen' through simple modeling exercises.[14] In short, understanding the sources of variation through trend and time series analysis offers opportunities to develop corrections or changes to processes to improve patient flow management.



State-run hospitals in Mexico collect three types of data that can be used for measuring patient flows.

(i) Data included in information systems: These are used to generate standardized indicators that are totaled or averaged on a biannual and annual basis.[15] These indicators are then used to prepare statistical abstracts and standard reports submitted to State Health Secretariats.

(ii) Data demanded by state authorities: These are for monitoring the implementation of selected policies and programs, as well as target compliance (e.g. reduction in C-sections, neonatal mortality, infection rates, etc.). Together with data from information systems, these data are useful for monitoring and target compliance purposes, but are generally not used to *systematically* improve quality, efficiency or outcomes at the facility level. Nevertheless, data already captured by the information system for reporting and target compliance purposes, such as numbers of admissions, discharges, ED arrivals, adverse events, and infection rates, among others, can be useful for patient flow analyses (see Section 9 below).

[14] Modeling can facilitate better resource planning (e.g. staff and overflow planning), enables identification and response to increases in utilization, and prevents bottlenecks due to poor scheduling. While sophisticated software exists for predictive modeling, most patient flow modeling can be performed with electronic spreadsheets (such as Excel) and relatively inexpensive decision tools (e.g. Excel "add-ons").

[15] These include: installed capacity (e.g. number of operational ORs), staffing by professional category, bed censuses, efficiency indicators (occupancy rates, bed turnover rates and ALOS by ward, ED, ICU, PACU), infection rates, births, mortality rates, production (number of admissions, discharges, ED and OP consultations, surgeries, diagnostic tests, meals served, pounds of laundry washed, etc.), main causes of mortality and morbidity (ED, OP, IWs), and number of referrals and counter-referrals. State health authorities irregularly compare trends across hospitals for a subset of indicators.

(iii) Raw data: Regularly collected but not necessarily compiled (systematically, at least) by the hospitals or included in standard reports, these data can be used to develop metrics that contribute to assessing (and improving) patient flows. For example, most hospitals keep daily and shift-based time logs and patient registries on OR start and end times, ED in and out times, ED and IW voluntary discharges, programmed and non-programmed surgeries, and admissions and discharges. Some hospitals maintain this data in hand written registers, while others enter the data in electronic spreadsheets. Importantly, given that daily and shift-based registers are already part of data collection systems in the hospitals, moving toward more time-sensitive data collection for patient flow purposes (e.g. hourly registers of voluntary discharges, programmed surgeries, bed availability, etc.) would be feasible.

Figures 9 through 12 provide examples from one hospital of metrics and corresponding trend or time series analyses that can be performed using available data.[16] While average ED wait times between ED admission and hospitalization (e.g. admission to a bed in an IW) averaged about 5.5 hours in August, 2016, Figure 9 shows that many ED patients had to wait up to 50 hours to secure an inpatient bed. Graphing the distribution of wait times can inform a deep-dive analysis to unravel the patient flow bottlenecks (such as IW admission delays) that contribute to overly long ED waiting times.

Figure 9: Number of Hours Between Admission to ED and Hospitalization, August 2016

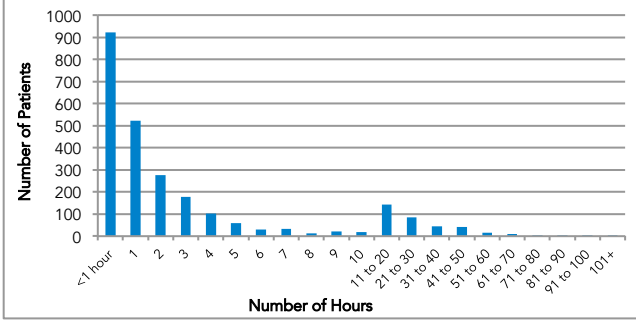
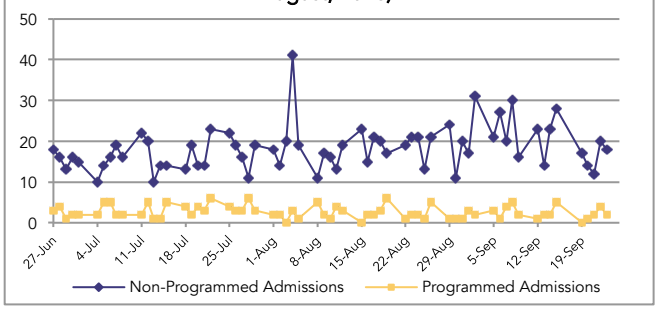
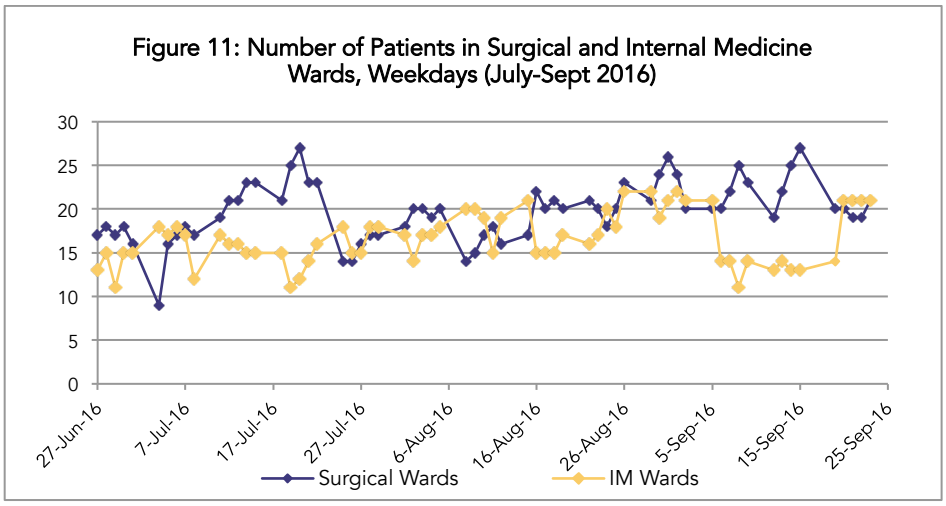


Figure 10: Number of Programmed vs. Non-Programmed Admissions, Weekdays Only (June-August, 2016)



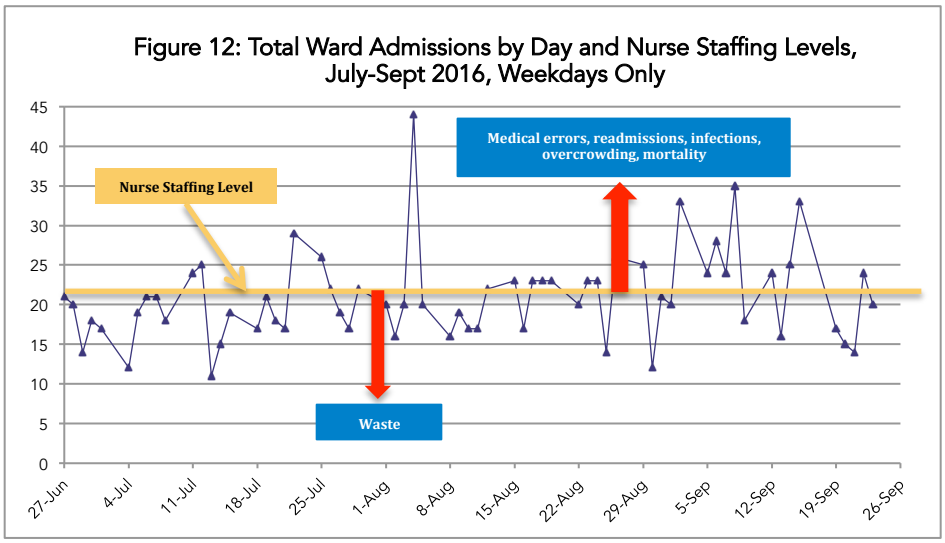
Applying time series metrics to run-charts (and Shewhart charts[17]) helps managers visualize and analyze variations in demand and production, identifying the day (and hour) they occur. The run chart illustrated in Figure 10 shows the large variations in programmed and non-programmed IW admissions by day over a three-month period in a sample hospital. Interestingly, the peaks in programmed admissions appear to correspond with the valleys in non-programmed admissions. There could be interplay between the two types of admissions, suggesting that some variation is "artificial" or non-random (e.g. driven by scheduling arrangements for programmed admissions)[18] However, with further analysis, the exact nature (if any) of this relationship could be determined.

[16] Data for Figures 9 through 12 were obtained from an in-depth assessment of patient flows in one of the sampled hospitals and were prepared by the investigative team.
[17] A Shewhart chart is a type of run-chart with time series data, but includes a mean and statistically calculated upper and lower limits.
[18] Non-programmed or emergency admissions respond to "true demand", which contains random or "natural variation." However, in most cases this variation is stable over time (except for epidemics) and therefore predictable and receptive to system redesign measures.



Similarly, Figure 11 depicts the variations in the number of occupied beds in surgical and internal medicine wards over a three-month period. While occupation rates for both wards averaged 80 percent, the chart shows large swings in daily occupancy rates, resulting in periods of congestion (e.g. bed unavailability) and underuse (e.g. "dead bed time"). More in depth analysis would help inform better bed management to smooth the peaks and valleys of bed occupancy.

Another way to examine time series metrics is displayed in Figure 12, which overlays nurse staffing levels on total daily IW admissions. Nurse staffing and per patient ratios are a well-established predictor of care quality and patient safety (see Annex 1). While staffing ratios are fixed, patient flows are highly variable. Errors are committed in overcrowded and stressful conditions, leading to readmissions, adverse events and mortality. On the other hand, low bed use leads to underuse of scarce resources. Metrics and analysis along these lines helps managers recognize peaks and valleys in occupancy and develop interventions to smooth variations or match staffing to demand.



Inspired by Litvak, 2016.

IX. Toward Relevant Patient Flow Performance Metrics in Low-Resource Settings

Robust patient flow metrics should allow hospital managers to answer a number of questions related to patient flow problems: What and where are the problems? How serious are they? When do they occur and how do they vary over time? What are their causes and impacts? What can be done to anticipate and improve patient flows? What are the management options and trade-offs?

Given resource limitations facing public hospitals in Mexico and other developing countries, addressing these questions should not require major investments in information and data collection systems, software or technologies.[19] International literature suggests that much can done to strengthen patient flow management practices through the use of readily available data, applying relatively simple methods (e.g. time series and trend analysis) and employing bottom-up implementation strategies based on multidisciplinary teams and cross-departmental learning collaboratives[20] (Greene et al., 2012; Etheredge, 2007; Ryckman, et al., 2010; Kibler et al, 2010; Weintraub et al., 2010; IHI, 2003).

Before proceeding with the recommended metrics, it is important to frame the discussion in the broader information environment of Mexican public hospitals. As mentioned in the previous section, adopting relevant but rigorous patient flow metrics will entail shifting the data culture of hospitals from information production for standard reporting purposes to analytics to produce knowledge and insight to facilitate organizational learning and, ultimately, provide guidance for improvement and planning purposes (see Figure 8).

To accomplish this, data demand and use will need to become more internally—rather than externally—driven. Importantly, the changing incentive environment in public hospitals in Mexico favors this shift. Through decentralization, the traditional command-and-control approach has diminished and many hospitals have been encouraged to innovate through their own initiatives to improve performance. Indeed, several have recently launched patient flow improvement initiatives to strengthen linkages with ambulatory providers to reduce the flow of patients with low acuity conditions (see Box 2). Most hospitals seek to expand direct payments from *Seguro Popular*, which pays a single (and fixed) package rate for certain high complexity procedures, requiring hospitals to provide such care more efficiently to avoid exceeding the established rate (such as by

Box 2: Hospital Initiatives to Address Patient Flow Challenges

Below are examples of initiatives taken by some of the sampled hospitals to improve patient flows.

- One general hospital worked with PHC units to offer consultations on Saturdays and Sundays. (Program was subsequently discontinued.)
- Group of pediatricians in one maternal-child hospital formed social media "Chat" groups to provide advice and respond to clinical problems raised by primary care physicians.
- Another general hospital is finalizing a manual for PHC facilities to guide referrals to OP and the ED from the PHC level, and the documentation and test results that should accompany patients.
- With the purpose of decreasing the flow of referred patients with chronic conditions, one large general hospital organized a telemedicine program with PHC centers and small rural hospitals to provide specialist e-consultations jointly with local general practitioners.

[19] We have already seen that improving patient flow management practices is an alternative to constructing new wards and adding beds and staff.
[20] Implementation strategies are not a subject of this report.

reducing extended stays, readmissions and medical errors). More recently, fiscal constraints stemming from the drop in international oil prices have resulted in across-the-board budgetary cuts, and are also driving hospitals to enhance efficiency. In sum, the changing incentive environment favors more efficient use of resources, and better patient flow management is one way for hospitals to keep within current revenue streams.

Hospitals are complex systems and no single measure is sufficient to inform management of patient flow problems and effective corrective measures. International literature suggests that a family of measures is needed to address the aforementioned questions. Further, any metric should be robust for multiple purposes: assessing problems, designing solutions, monitoring progress and evaluating impact. The following criteria should be considered when selecting specific metrics:

- Location: Different metrics will be required for different units and levels of care. Some will be departmental specific, others hospital-wide, embracing the entire organization, and still others system-wide, comprising the hospital and facilities in its catchment area. The latter will involve, for example, linkages with other providers (e.g. primary care facilities).
- Type: Patient flow metrics can be broadly grouped into three categories, though some overlap exists:
    - *Patient flow outcome measures*, which are oriented toward reducing wait times (including boarding time) and patient flight, increasing throughput, and decreasing congestion, cancellations and delays in service times.
    - *Measures of flow variation*, which consists of taking a subset of patient flow outcome measures together with other metrics and examining them over time (day of week, time of day) to understand patient flow patterns, analyze peaks and valleys in demand and throughput, and detect possible causes of patient flow failures. Understanding variability–whether it is artificial (non-random) or natural (random)—is key to crafting a proper management response.
    - *Impact measures*, which are important to show quantitative impacts of "good" and "bad" patient flow management practices on care delivery and patient well-being. This can be accomplished by linking patient flow variability and outcome metrics to impact measures related to quality, patient safety, patient satisfaction, spending and outcomes. Unfortunately these measures may not be readily available at the departmental level.
- Data Availability and Metric Feasibility: Most informative analyses of patient flow problems (and solutions) can be based on data and metrics already available in hospitals' information systems and data registers. Slight adjustments to data collection systems will allow for the generation of additional metrics, but the data will have to be complied on a regular basis, placed in forms that facilitate trend and other analyses (e.g. run charts) and metric development, and allow for simple statistical analysis, if needed.[21] Data-to-metric formation should be both feasible and easily derived (and validated) from the registers (e.g. door to treatment times in the ED). A subset of more time sensitive metrics will require some additional effort (e.g. admissions and discharges by hour of day), but can be feasibly collected.

[21] Patient flow analyses tend to involve simple descriptive statistics, such a means, ranges, standard deviations, coefficients of variation and tests for randomness (i.e., Poisson distribution with chi-square test). All are available in standard spreadsheet software.

Table 1 presents examples of recommended metrics to gauge and improve patient flow management practices based on this scoping exercise. The list does not include metrics that are already available from hospitals' information systems and can be used for patient flow analysis (average length of stay in ED, IWs, ICUs and PACUs, bed occupancy and turnover rates in IWs, length (in minutes) of surgical procedures, voluntary discharges in ED and IWs, etc.). However, some of these existing measures may require more frequent and time-sensitive data collection (e.g. by day or shift).

The metrics presented in the table build upon measures and data already available in information systems and registers. A limited number are new metrics, but required data can be easily collected through current registers or with minor adjustments thereof. The idea is that the recommended metrics be tested during a subsequent "intervention" phase of the proposed patient flow project. It is worth repeating that the data compilation, metric development, and analytics recommended here are quite feasible in the public hospital environment in Mexico. They do not require major training, additional staff, the application of complex methods, or investments in sophisticated software. However, methodologically assessing, managing and improving patient flows, including metric development and analysis, will require strong buy-in from state health officials, hospital managers and front-line staff.

Table 1: Examples of Feasible Metrics to be Tested in a Phase 2 "Intervention" Project in Mexico, by Location, Type of Measure and Data Availability

Metric	Location	Type of Measure			Data Availability
		PF Outcome	Flow Variability	Impact	
Department Specific Measures					
No. and ALOS (hours) of patients in overflow units, observation rooms, boarding areas and hallways waiting to be admitted to IW beds by day and hour	ED		X		Patient data available; LOS requires additional data collection
No. of patients who left without being seen by day	ED	X			Will require registration of arrival time
Average patient waiting time by day and shift from door to treatment and from treatment to release (or IW admission)	ED	X	X		Data available; may require registration of arrival time
No. of inpatients in overflow units or placed in inappropriate IW by day and shift	IW	X	X		Data available
No. of admissions (programmed and non-programmed) and discharges by IW by day/hour	IW		X		Data available by shift; hourly registration required
Time between order and actual patient discharge and admission by day and shift	IW		X		New metric; feasible collection
No. of discharges within 2 hours after deemed medically ready by day	IW	X			New metric; feasible data collection
Time from decision to have emergency surgery to OR	ED, OR				
No. of delayed, refused or cancelled surgeries by day and shift	OR	X	X		Data available
Actual and scheduled start times for elective surgical cases by day and shift	OR		X		Data available
Hospital-wide Measures					
No. of length of stay outliers per month	ED, IW, ICU, PCU	X			New metric; feasible data collection but requires outlier definition
No. of hospital acquired infections during high utilization periods	ED, IW			X	Data available; time sensitive registration required at dept. level
No. of adverse event during high utilization periods	ED, IW, OR			X	Data available; time sensitive registration required at dept. level
Readmissions within 30 days of discharge by month	IW			X	Data available
Patient satisfaction/experience scores related to waits and delays by day	ED, IW, OP			X	New metric, requiring instrument development and data collection
Worker satisfaction scores related to workload (by shift)	ED, IW, OP			X	New metric, requiring instrument development and data collection
Health System-wide Measures					
No. of low-acuity patients treated and released by day	ED, OP	X			Data available by shift; hourly registration required
No. of low-acuity patients arriving with referral from PHC facility by day	ED, OP	X			Data available by shift; hourly registration required

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