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Development of a Productivity Assessment Tool for Hospital Settings in Iran: A Delphi Study

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ABSTRACT

Background: Measurement of the organizational performance would be effective and helpful for improvement, in the case that it is based on an appropriate and principled system. Such a system uses specific indicators to measure the productivity and performance of the organizations. In fact, these indicators act as useful tools for strategic planning in managerial levels. Given the importance of the issue, this study aimed to develop the key productivity indicators for hospitals affiliated to Isfahan University of Medical Sciences. These indicators are designed to be applied in evaluation, implementation, and improvement processes of the organizations under study.

Methods: This was a qualitative study conducted among the hospitals affiliated to Isfahan University of Medical Sciences in 2015. Purposive sampling method was applied and the study participants were selected through snowballing. Then, the participants were organized in a focus group consisting of 16 experts in the field of hospital performance and efficiency indicators to achieve the research objectives by using indexing matrix method. Finally, validity of the developed indices was confirmed using Delphi method.

Results: A total of 42 productivity indicators were formulated. Of these, nine indices were input (structural), which included financial, human resources, and energy consumption indicators. The next 29 indices were output and mainly belonged to the financial, efficiency, and quality area. The final four indices included process indicators and consisted of length of stay in emergency department, waiting time for out of hospital counseling, and waiting time for the presence of resuscitation team at the patient bedside during the cardiopulmonary resuscitation.

Conclusion: Development of the indicators in three areas of input, process, and output helped managers and policy makers to access reliable and valid instrument for measuring organizational productivity.

Keywords: Indicator, Performance, Efficiency, Hospital

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Introduction

Not only employees need to be recognized for their efforts and contributions in the workplace, but also a necessity exists for managers to be constantly aware of the organization performance. In this way, personnel will be encouraged to put more effort in working and organizational weaknesses will be discovered as a result of the ongoing assessments (1). The requisite to increase an organizational performance including productivity is principally obvious in the healthcare industry. The need for effective distribution and application of the healthcare resources has been recently more emphasized all over the world concerning the increased cost and waste of resources in this area (2). Healthcare institutions pursue the main objectives of delivering high quality services to improve population health and considering efficiency in utilization of the available resources due to their scarcity (3). This issue is specifically important in hospital settings, which absorb more than half of the health budget (4). Therefore, evaluating hospitals' performance plays a significant role in identifying and even preventing the probable inefficiencies and resolving them within the most appropriate time (5).

In order to measure the hospital productivity in a quantitative, unified, and principled way, appropriate measures should be defined and applied. European Association of National Productivity Centre (EANPC) defined productivity as “how efficiently and effectively products and services are being produced" (6). In a general concept, productivity is the ratio of output yielded from a process activity per unit of input, which encompasses main measures in three categories of input, process, and output (7). Based on the given definition, productivity indicators depict how well the available resources are utilized and yield outputs. They also describe the work process efficiency and measure the appropriateness and relevance of the activities done in delivering services (8). Equipment, human, and financial resources used for a particular program are input indicators that measure the amount of resources devoted for a specific activity. Compliance rate with standard practice, average length of stay, and bed turnover are among the process indicators mainly related to services provided from different aspects of quality, time, and money. Finally, the amount of services provided as a result of the process activities is categorized as output measures, which represents the quantity of product or services rendered through particular resources (9).

To determine the indicators needed for productivity measurement in a health sector, the hospital circumstances and its related significant issues should be investigated. In general, taking in to account a set of indicators in all three mentioned areas can help managers to assess the organizational performance in an effective and comprehensive manner (8). In Iran, we are faced with the lack of research on developing productivity measures in hospital settings particularly in a detailed format due to the insufficient statistics on the field and little attention given to hospitals' potential for increased efficiency (10-13). However, since the adoption of Article 5, Clause A of the Sixth Development Plan about productivity and the necessity for its measurement, many organizations, including hospitals have begun to pay special attention to the issue and developed appropriate indicators for measurement (14).

Thus, logical use of resources has become a significant concern among the healthcare organizations, which was directly associated with the finest resource utilization for delivering services (15, 16). A study conducted in Iran revealed that in most Iranian hospitals' input, process, or output indicators were used to assess the productivity (17). This study was conducted considering the importance of performance improvement including productivity in Iranian hospitals, as the core institutional providers in the health system. The aim was to provide a set of indicators used for productivity measurement in the hospital settings. These indicators should be applied in evaluation, implementation, and

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improvement processes of the organizations under study.

Materials and Methods

This qualitative study was conducted in hospitals affiliated to Isfahan University of Medical Sciences in 2015. Purposive sampling method was used to select study experts by snowballing. The participants were organized in a focus group discussion (FGD) consisting of 16 experts in the field of hospital performance and productivity indicators (Table 1). These participants also included members of the productivity committee working in Isfahan hospitals to achieve the research objectives through use of indexing matrix method. The FGD was held for two hours in July 2015 and facilitated by a research member. Later, the audio records were transcribed to determine the productivity measures from experts' points of view. To select the most appropriate set of indicators a Delphi technique was used. All 16 experts accepted to continue their contribution in the study. After receiving the initial developed checklist for indicators, study participants were asked to review and improve each of the proposed measures based on their knowledge and executive experiencers. These measures considered the possibility for measurement and data collection regarding the verified indicators. They also indicated their compatibility with the hospital strategies. After a month, comments given by all study experts were collected and productivity measures were finalized in two rounds. After each round, one of the researchers acted as the facilitator and provided a summary of experts' opinions. In this regard, the participants were encouraged to review their earlier replies and revise them as necessary. Finally, after achievement of consensus, the indicators defined in four areas of financial, human, efficiency, and quality were organized in three categories of input, process, and output. Then, the research team defined the calculation formula and unit of measurement for each of the measures.

Ethical considerations: Considering that analysis of these indicators is a basis for senior managers' judgments about the efficiency of a hospital, all financial, human, productivity, and quality aspects should be taken into account to have accurate and fair judgment about a hospital. The researcher tried to consider the above aspects regarding the important activities of the hospital departments in designing the indicators. Informed consent was obtained also.

This manuscript is the result of a research project with the ethics code of IR.Mui.Rec.1394.2.051.

Results

Experts identified the most important hospital productivity measures and agreed on 11 input (structure) indicators, which are shown in Table 2. In this Table, the calculation formula, unit of measurement, and time period are depicted for calculating the indicators.

The second category for productivity measurements belonged to the process indicators shown in Table 3.

Final category of the productivity measures was related to the output indicators shown in Table 4.

Table 1. Demographics of the participants in the Delphi technique

Number	Age	Female	Man	Degree of education
16	31-45	11	5	5 P.H.D / 2 Expert / 9 MA

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Table 2. Input productivity indicators verified for hospitals affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
Per capita energy consumption (water) per bed	Amount of water consumed during a season / Average number of active beds in the season	M^3 per bed	Every three months
Per capita energy consumption (power) per bed	Amount of power consumed during a season / Average number of active beds in the season	KW per bed	Every three months
Per capita energy consumption (gas) per bed	Amount of gas consumed during a season / Average number of active beds in the season	M^3 per bed	Every three months
Nursing shifts per bed	Total number of nursing shifts per month / Number of active beds in the month	Ratio	Monthly
Number of specialists per active bed	Number of specialists working during a season / Number of active beds in the season	Ratio	Every three months
Ratio of operating room staff per surgeries	Number of technical staff working in the operating room in a month / Number of surgeries in the month	Ratio	Monthly
Ratio of official and financial staff per active bed	Number of official and financial staff in a year / Number of active beds in the year	Ratio	Yearly
Ratio of clinical staff per active bed	Number of clinical staff in a year / Number of active beds in the year	Ratio	Yearly

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Ratio of para clinical staff per active bed	Number of para-clinical staff in a year / Number of active beds in the year	Ratio	Yearly
Ratio of non-pharmacopoeia prescribed drugs	Monetary value of non-pharmacopoeia prescribed drugs / Monetary value of total drug purchasing	Ratio	Every six months
The proportion of drug costs to total costs	Total hospital drug costs in a year / Total hospital costs in the year	Ratio	Every six months

Table 3. Process productivity indicators verified for hospitals affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
Patients' waiting time in emergency department (ED)	Number of hospitalization hours for patients admitted in ED / Number of hospitalized patients in ED	Hour	Monthly
Patients' waiting time for out of hospital counseling	Number of hours between the request time for out of hospital counseling and consultation time	Hour	Monthly
Patients' waiting time for inside hospital counseling	Number of hours between the request time for inside hospital counseling and consultation time	Hour	Monthly
Waiting time for the presence of resuscitation team at the patients' bedside during CPR	Number of hours between the announcement of CPR code and the presence of resuscitation team at the patients' bedside	Moment	Monthly

Table 4. Output productivity indicators verified for hospitals affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
Ratio of deductions imposed on inpatients from social security insurance	Amount of imposed deductions from social security insurance during a season / Total monetary value of sent documents to social security insurance	Ratio	Every three months

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Continue Table 4. Output Productivity Indicators Verified for Hospitals Affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
Ratio of deductions imposed on inpatients from health insurance	Amount of imposed deductions from health insurance during a season / Total monetary value of sent documents to health insurance	Rial	Every three months
Ratio of deductions imposed on inpatients from armed force insurance	Amount of imposed deductions from armed force insurance during a season / Total monetary value of sent documents to armed force insurance	Rial	Every three months
Ratio of deductions imposed on inpatients from relief committee insurance	Amount of imposed deductions from relief committee insurance during a season / Total monetary value of sent documents to relief committee insurance	Rial	Every three months
Ratio of pharmaceutical returns per total drug purchasing	Monetary value of Pharmaceutical waste + expired drugs / Monetary value of total purchased drugs	Rial	Every six months
Cost to income ratio	Amount of specified revenue dedicated to hospital costs in a year / Total amount of hospital specified revenue	Rial	Yearly
Proportion of expenditures from specified hospital revenue per total costs	Amount of specified revenue dedicated to hospital costs in a year / Total amount of hospital costs	Rial	Yearly
Ratio of discounts given by socialist work unit per total hospital revenue	Amount of discounts given by socialist work unit / Total hospital revenues	Rial	Yearly

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Continue Table 4. output productivity indicators verified for hospitals affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
The average cost of occupied day beds	Total hospital costs spent from current and specified budget in a year / Total occupied day beds in the hospital	Rial	Yearly
Ratio of pharmaceutical and medical equipment expenditures per total monthly revenue of the hospital	Amount of pharmaceutical and medical equipment expenditures / Total monthly revenue of the hospital	Rial	Monthly
Patients' average length of stay in non-surgical inpatient units	Total occupied day beds in non-surgical units during a season / Number of discharged or dead patients in similar units in the same time period	Ratio	Every three months
Patients' average length of stay in surgical inpatient units	Total occupied day beds in surgical units during a season / Number of discharged or dead patients in similar units in the same time period	Ratio	Every three months
Patients' average length of stay in intensive care units	Total occupied day beds in intensive care units during a season / Number of discharged or dead patients in similar units in the same time period	Ratio	Every three months
Bed occupancy rate	Total occupied day beds in a month / Total day beds in a similar time period	Ratio	Monthly
Bed turnover rate	Number of discharged or dead patients in a month / Average number of active beds in a similar time period	Ratio	Monthly

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Continue Table 4. Output productivity indicators verified for hospitals affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
Bed turnover interval	Number of ready day beds_ number of active beds in a month / Number of discharged or dead patients in the same time period	Ratio	Monthly
Ratio of surgical procedures performed per operating room bed	Number of surgeries done in a month / Number of active operating room beds in a similar time period	Ratio	Monthly
Per capita specialized visits for outpatients	Number of visited patients in a hospital clinic in a month / Total number of specialists working in hospital clinic in a similar time period	Ratio	Monthly
Per capita consumption of antibiotics per occupied day bed	Number of consumed antibiotics in a hospital in a month / Occupied day beds in a similar time period	Ratio	Monthly
The percentage of hospital's accreditation score per the mean score of province hospitals	(Accreditation score obtained by a hospital / Accreditation mean score of province hospitals) *100	Percentage	Yearly
Percentage of reported errors	(Number of reported errors in a hospital in a month / Total number of inpatients in a similar time period) *100	Percentage	Monthly
Gross mortality rate	Number of patients died after 24 hours passed from admission time / Number of discharged +dead patients _number of patients died before 24 hours passed from admission time	Ratio	Monthly

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Continue Table 4. Output productivity indicators verified for hospitals affiliated to Isfahan University of Medical Sciences

Indicator	Formula	Unit of Measurement	Calculation Time Period
Crude mortality rate	Number of patients dying in a month / Number of discharged +dead patients in a similar time period	Ratio	Monthly
Ratio of documented complaints in a hospital	Number of documented complaints in a hospital in a month / Total number of inpatients in a similar time period	Ratio	Monthly
Ratio of discharged patients against medical advice	Number of patients discharged according to medical advice in a month / Total number of discharged patients in	Ratio	Monthly
Ratio of discharged patients according to medical advice	Number of patients discharged against medical advice in a month / Total number of discharged patients in a similar time period	Ratio	Monthly
Hospital acquired infection rate	Number of acquired infection cases reported in a month / Total number of hospitalized patients in similar time period	Ratio	Monthly

Discussion

This study determined 11 input indicators, which were considered as the essential infrastructure factors for successful implementation of programs aiming to improve health. In fact, measurement of different productivity measures helps managers and decision makers to improve their awareness about availability of resources and the way they are utilized to produce the healthcare services. This knowledge also helps them to plan more effectively and efficiently in implementing health objectives with optimum use of resources. The number of clinical staff delivering healthcare services, the amount of energy consumption per active bed, and the cost per specific drug were among the most important input indicators. Similarly, literature mentioned the amount of resources utilized for a particular medical procedure and the number of nursing staff ready to deliver healthcare services as the input hospital measures (18).

Study experts defined 29 output indices, which reflect the results of process activities and measure the amount of the provided services, quality, and efficiency of the production. For example, the ratio of deductions imposed by health insurance companies depicts the degree of medical records' completion and the accuracy of activities conducted by income and discharge department in compliance with rules dictated by relative value book. Through assessing the relative causes of

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deductions, managers can play an effective role in increasing the hospital revenue and decreasing the possible loss of funds. Measurement of the revenues not received from patients or sponsoring organizations also provide important information for hospital decision makers to discover the root causes of the problem and consequently to solve them in an appropriate manner. Cost of the income ratio as another defined measure indicates quantity of the hospital profits or losses, which offers a model for resource planning and allocating. Indices of the average length of stay, bed occupancy rate, and bed turnover are among the productivity measures, according to which, a manager can get comprehensive overview of hospital activities and related quantitative and qualitative performance. Inappropriate use of antibiotics brings unnecessary costs for the hospital and endangers the patients' safety. Therefore,, defining and monitoring the associated indicator representative of the antibiotic amount in clinical departments help the authorities to control the hospital infection and the pharmaceutical committee to make more logical decisions. Hospital mortality rate, patients' complaints, and scores achieved in accreditation program were other key indicators in transferring the important information to the policy makers to recognize the hospitals' performance, weaknesses, and ways to improve. Literature has identified hospital measures including average length of stay, cost per active bed, and cost per outpatient visits as output measures (19-21). The number of patients discharged from hospital in a particular period of time and physician visits were among the other popular measures defined and considered in many studies (22-25).

Finally, four process indicators were determined, which mainly emphasized on the appropriate time for delivering services to patients in order to achieve the optimum results from their treatment. Therefore, measurement of such indices would be an effective step in re-engineering and optimizing processes in healthcare provision. Despite the useful information provided by these measures, a significant constraint exists in this regard. Such indicators did not consider the changes in quality over time. Consequently, literature introduced cost per unit of quality-adjusted health care services as a desirable measure. The reason is that adjusting health care expenditures with regard to the quality ultimately causes a major decrease in health prices (26, 27). Therefore, regarding the output measures, qualitative variables such as patients' satisfaction should be defined and used in continuous monitoring of hospital performance. Furthermore, in terms of the input indicators, it would be helpful to incorporate the important variables relied on by hospitals to produce and deliver services. Through identifying a comprehensive set of indicators, policy makers and those responsible for evaluating the hospital performance can benefit from the determined productivity measures to continuously make an improvement in healthcare organizations' performance.

Limitations of the study

Considering the limitations and problems of this research, the following can be mentioned: the lack of related research on productivity in hospitals and the existence of various definitions and perceptions about productivity and indicators by authorities in hospitals

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Conflicts of interest

The authors declare that they have no conflict of interests.

Authors' contributions

Mahdiyan S and Ferdosi M designed research, Askari R and Rafiei S conducted research and analyzed data ,Askari R and Rafiei S wrote the paper. Askari R had primary responsibility for final

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content. All authors read and approved the final. (manuscript)

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