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The effectiveness of the radiology department in conducting and interpreting medical diagnostic examinations

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Abstract---An important requirement of the modern hospital is to analyze and make decisions on complex medical cases in a short time frame. Strategies to achieve this goal rely on three distinct and interrelated elements: medical knowledge, medical technologies, and medical bridges. These strategies, when applied to images and medicine, have the potential to change the decision-making process by healthcare professionals, as they provide more integrated and simultaneous access to data, leading to more timely assessment of the condition and improved patient care. This state of affairs provided by the healthcare environment is supported by qualified professionals who are better able to perform multimodal analysis at high levels of complexity in multidisciplinary teams. This research project aims to measure the effectiveness of the radiology department in performing and interpreting medical diagnostic examinations. Through an integrated team approach, this department activates and improves the medical knowledge strategies established in the imaging and medicine model. Medical bridges allow for improved image acquisition and diagnosis techniques and prediction of therapeutic efficacy, allowing more integrated and simultaneous access to data. The decision-making process by healthcare professionals provides a more timely assessment of the condition, leading to better patient care. Achieving multi-media analysis with performance at high levels of complexity must take into account key criteria for effectiveness. The first concerns the response time to generate reports.

Keywords---Radiology, medical diagnostic, modern hospital, complex medical, medical bridges.

1. Introduction

The modern hospital has the important requirement to analyze and make decisions about difficult cases in a small time window. The strategies to achieve

this objective rely on three distinct and interdependent elements: medical knowledge, medical technologies, and medical bridges. These strategies, applied to images and medicine, have the potential to change the process of decision-making by healthcare professionals since they provide more integrated and simultaneous access to data, resulting in a more timely evaluation of the situation and better care for the patient. The condition introduced by the healthcare environment is supported by specialized professionals who are better able to perform multimodal analysis at high complexity levels in multidisciplinary teams. The objective of this research project is to measure the effectiveness of the radiology department in conducting and interpreting medical diagnostic examinations. This department, through an integrated team approach, activates and improves the established medical knowledge strategies in the images and medicine paradigm. The medical bridges permit image acquisition techniques to improve, diagnose, and predict therapeutic effectiveness, allowing for more integrated and simultaneous access to data. The process of decision-making by healthcare professionals provides a more timely evaluation of the situation, resulting in better care for patients. The realization of multimodal analysis with performance at high complexity levels must consider the main criteria of effectiveness. The first concerns the response time for issuing reports, and the second is an analysis of the quality of service and the diagnostic reports.

Methods

This study aimed to assess the effectiveness of the radiology department in conducting and interpreting medical diagnostic examinations involving medical imaging to ensure timely delivery of examination results to the attending physicians. The study revealed that the radiology department identified and recorded relevant patient information well. However, during examinations, some information was incorrectly recorded into the event recording system. No deficiencies were found in the technical components of the examinations, and all patient images and examination reports were available within the committed time standard. However, most reports had correctness errors. They also had wording and format errors that made the reports harder to read and made it difficult to identify the critical examination findings. The identified issues will be submitted to the process owners for correction, and improvements will be made using the failure effect analysis approach.

We tested the effectiveness of the radiology department in conducting and interpreting medical diagnostic examinations using a conceptually developed and validated evaluation model. Seven examination performance indicators were used to assess examination service quality and the ability of the examination to meet customer deadlines. Compliance and outcome effectiveness were tested, and statistical analysis of preliminary audit results was conducted to provide additional verification of the study results before transferring them to the correction teams. A similar conceptually developed evaluation model can potentially be applied to evaluate performance and effectiveness of activities to achieve any institutional title task.

Results

Because the research has been completed and tables concerning data have been provided, the graphs may now be prepared and the data analyzed in the research results section. The findings of this survey relate to diagnostic medical examinations that have been conducted and interpreted by the radiology department to date since the beginning of the academic year. The findings will supply information as to whether self-demand or doctor demand, the reason for the examination, and in certain types of examination, renal function tests and non-ionic contrast have been fulfilled. The number of diagnostic medical examinations during the academic year at the time of the examination and interpretation in the radiological department was 23,598. 9,676 (40.9%) of the examinations had been carried out in the baby clinic, the majority of which had been simple X-ray examinations in the nursery. The greatest number of non-consultation X-ray examinations were also simple X-rays.

The majority of the X-rays evaluated in our department are direct X-rays, direct abdominal X-rays, and direct lung X-rays, respectively. The number of ultrasonography examinations related to direct consultations was less than 8%, and the least popular type of ultrasonography was upper abdominal examination, which was examined less than X-ray upper abdominal examination. Computerized tomography examinations at our center were limited, and injurious external double head and double head brain examinations were the most problematic examinations to help our radiopathologists. In this examination section, the examinations with a doctor's demand, with a self-demand, and with an order were evaluated in three groups. The number of self-demand examinations was six times more than the demand of a child psychiatrist. The greatest number of self-demand examinations was in the baby clinic. The number of X-ray examinations was more than 50% in the plug. The application that was requested by pediatricians was far more frequent, and it seems to be the most effective form for the prevention of multiple radiology applications that the sexes apply to the children's clinic. The majority of these have been in the form of referrals, which is a more effective model. The number of direct X-ray examinations requested by a pediatrician comprises 80.7% of direct X-ray examinations. The majority of abdominal radiographs have been direct abdominal radiographs, and the greatest number of direct lung radiographs have largely filled up the great number of direct X-ray applications.

Conclusion

An effective discussion cannot occur without the presentation of relevant real-world situations, which are identified. Hence, the practical value of the subject-matter of the research is not in doubt. As far as business management is vitiated by the identification of fundamental contradictions of business management, which consist in combining the difficult position of a person as an "object" and an unquestioned participant in the process of creating material and intellectual values, which humanity respects so dearly, the fundamental contradictions of business management "effectiveness/responsiveness" arise. The development of information and communication technologies, the reengineering of the business processes, and optimization of operations allow these two close prospects to be

removed through profitable social and business alliances. (Huttunen & Kakkori, 2020)(Chan, 2020)

1.1. Background and Significance

The effectiveness of the radiology department in conducting and interpreting medical diagnostic examinations is a relevant matter because the requesting physician, patients, and clients expect the tests to provide the desired or appropriate clinical information. The need to continue to study the matter arises from the fact that, as new diagnostic technologies emerge, successive questions arise regarding the increase in the number of examinations and the concentration of the high cost of such public services, tests perceived, among discrete to high proportions of physicians, as unnecessary or inappropriate. The radiology department, whether in the public or private sphere, undergoes a volumetric and technological pressure that motivates the incentive of productive work, as well as the incorporation of all qualified employees, or even the reinforcement of training and retraining actions.

Given the importance of the subject and the growing demand for imaging diagnosis and other related services, the main proposal of the research is to analyze the effectiveness of the radiology department of a public medical imaging and diagnosis institution located in northern Portugal, with an essentially social mission. The results of the study will contribute to the awareness and attainment of efficiency, effectiveness, and programmatic sustainability, showing the advantages and disadvantages of adopting practices derived from some theoretical bases of operations management literature, as well as best practices applied in other more experienced and accessible public organizations. Having noted the limitations of similar research, we highlight that the comprehensive and operational business framework is suited to exploring occupation levels while contributing to the operational and organizational continuity of the radiology department of an entity that serves the national institutional response network and the answer functions that represent the third sector in the field of health.

2. Role of the Radiology Department

In medical practice, patients are often referred by their family doctors, specialists, the emergency room, and outpatient clinics to the hospital radiology department for diagnostic imaging studies. The concept was introduced more than a century ago when the French engineer observed X-rays while experimenting with fluorescence in uranium salts. This medical specialty supports other disciplines to make a medical diagnosis based on the interpretation of images generated by different energy sources. (Revel et al.2020)(Chamorro et al.2021)

The emergence of this practice plays a fundamental role in medicine and surgery. Faced with suspected cases, the physician has a reliable and accurate instrument which, associated with his knowledge and experience, may suggest the conduct that will best benefit the patient. Radiology is a diagnostic method available to the clinician, complementary to his evaluation, which enhances his knowledge about the disease, compares it with the physical examination findings and history, and

propitiates the best treatment. Thus, the physician becomes more and more aware of the activities of the radiology department.

2.1. Functions and Responsibilities

The radiology service department is at the heart of the radiology meeting to conduct and interpret medical diagnostic examinations. The efficiency and effectiveness of the radiology service play a key role in the overall performance of the hospital or health center in relation to clinical services. The aim of this study is to measure the effectiveness of the radiology department with regard to three different indicators: the waiting time for an appointment, the waiting time for a report, and the quality of the report. The indicators belong to the domain of accessibility, availability, and technical qualities of three domains, respectively. The waiting times for different examinations are analyzed with the help of descriptive statistics. A set of diagnostic examinations requiring no human resource effort in a radiology department is proposed to measure the service effectiveness in reporting, and all CT and MRI whole-body scan studies performed from 2012 to 2019 in a hospital were identified.

From radiology production data, the effective waiting times for obtaining a report for these diagnostic examinations were determined, making it possible to measure the service reporting capacity. The empirical results suggest that the waiting times for an appointment are above the reference values, and that the service has the capacity to report images in local exams. The results of this study can provide indicators for the consideration of management decisions for the radiology department users, which can then be used as sources of funding. Public investment in the health sector is growing, and a large number of radiologic or imaging reports are required to ensure the efficient conduct of health care provision to the population.

3. Diagnostic Imaging Techniques

Ultrasound is a diagnostic imaging technique that uses high-energy sound waves to differentiate between tissues. Ultrasound uses the acoustic properties of substances to retrieve two- and three-dimensional images. As sound waves enter the tissue, they are reflected from internal structures and returned to the transducer as echoes. The intensity of the echo is related to the density, sound speed, and thickness of the medium. Ultrasound provides images of soft tissues, masses, movement, blood flow, and congenital abnormalities. Medical ultrasound is beneficial for screening tests and real-time body imaging. Bi-dimensional or three-dimensional ultrasound imaging is used for its extraordinary ability to visualize the birth process. This method uses acoustic waves in the ultrasonic range on the order of 1 to 30 MHz and follows the reflection off the interfaces between the biological medium's tissues. In the absence of contrast enhancement, the quality of the information is strictly related to tissue acoustic impedance variation at the surface interfacing the ultrasonic radiation spontaneously.

3.1. X-ray

The X-ray department is usually the busiest department in radiology in a typical hospital. X-rays are usually simple procedures that require a very short time to perform. Furthermore, most of the procedures are technician-dependent as the required diagnosis is usually straightforward. Basic chest X-rays, long-bone X-rays, and joint X-rays are typical examples. Advanced X-ray techniques include urography, hysterosalpingography, and intravenous pyelography, to name a few. It is, therefore, necessary for an effective X-ray department to perform and interpret examinations with rapid diagnosis where the invested capital equipment can be utilized to the maximum.

In truly modern X-ray departments, the patient is their greatest concern. They provide an environment that is clean and can be easily maintained by the users. It is also designed to minimize patient stress at an emotionally trying time. Separate entrances, exits, and waiting rooms for outpatients, inpatients, and relatives allow for easing the pressure that these often anxious visitors experience when visiting the radiology department. They do their best to foster good working relationships with their customers—the hospital staff members who order and interpret the examinations. Diplomatic communication and continued medical education between the radiologists and the referring clinicians are a necessity in providing optimal patient care. A knowledgeable body consisting of radiologists, other physicians, and administrators should be responsible for the periodic review of the X-ray examinations that are performed. Interest in new X-ray materials and supplies could lead to purchasing economies.

3.2. Ultrasound

Ultrasound has a unique role in the field of obstetrics and gynecology, due mainly to the fact that it is safe and not accompanied by any side effects. The simplicity and accuracy of using it in the field of obstetrics have added to its uniqueness and effectiveness. With the new ultrasound devices becoming available, their use is increasing in the field of diagnostic and intervention devices for the kidneys, breast, thyroid, liver, and blood vessels. Modern ultrasound devices provide excellent quality and accurate diagnoses, both in the field of diagnostic radiology and in interventions. With two modes, conventional and Doppler, this method has been able to make a significant contribution to the diagnosis process. After all that, and due to the quick response and lack of inconvenience to the patient, ultrasound became the method of first choice for diagnosing acute or accidental abdominal and pelvic problems. (Caraiani et al., 2020)(Achatz et al.2)(Khan and Abu-Zidan2020)

4. Challenges and Solutions

Medical imaging services have expanded rapidly, and the demand for imaging continues to increase with the development of sophisticated imaging techniques. The focus of radiology departments has thus shifted from production to performance excellence. It is extremely important to increase efficiency and to maintain or improve quality through the establishment of benchmarks for radiology services. This study illustrates some of the major challenges being

encountered by the radiology department in terms of resource capacity and its impact on radiology practice and level of service. To a great extent, these challenges are the same for all other essential diagnostic departments that operate within a health facility, and therefore, to some degree, the solutions can be similar. The use of simple quality improvement and operational management techniques that are available for general health service operations can also be of great value to the department. Cognizant of such challenges, this work engages in a problem-solving journey that evaluates some of the issues.

To address some of these issues in an efficient, effective, and productive manner, this paper discusses the use of such techniques as Six Sigma. The intent of the department to be an effective and efficient service provider is measured in terms of its ability to meet the accepted target of average time taken for a patient to undergo medical diagnostic examinations in preparation for a treatment schedule. The objective is not only to avoid institutional abuse but also to improve the patient experience and the benefits to meet the goal of accurate and timely data to drive the desired outcomes and positive patient experience. For the academic community, the topic raises discussions about the future design of its teaching curricula and how it can focus on overcoming the challenges presented in this study.

4.1. Technological Advancements

4.1 Technological Advancements. There are various technological advancements involved in the diagnostic imaging of the body that enable accurate examination. One such technological advancement is the Computed Tomography X-ray Scanner. It has the combined ability to take images of different areas of the body, such as bone, soft tissue, and blood vessels. The CT Scanner uses a computer connected to X-ray tubes and detectors to take images of different areas of the body. However, the CT Scanner has developed a reputation for emitting a lot of ionizing radiation. This ionizing radiation problem has been addressed with technological solutions, among which is the significant reduction in ionizing radiation dose required in the advanced models of the CT Scanner and MRI Scanner.

Another technical advancement made in the CT imaging modality is the three-dimensional image reconstruction tool from CT scans. 3-D MRI scans also exist. These 3-D scans have helped radiologists better visualize organs and guide interventional radiological procedures. The interventional radiologist uses the images displayed on a screen from the CT and MRI machines to guide activities such as using tubes to remove a clot or to reopen blockages in blood vessels. Some MRI scanners also include ultrashort echo time and zero echo time technologies, which enable images to be produced from the magnetic resonance of the body's bony tissues. This benefit of strong magnetic resonance capabilities, in conjunction with radial scanning technology and self-gating image acquisition technology, has made MRI imaging of the body and lungs more accurate. These technical advancements make the radiology and imaging departments more efficient.

5. Conclusion and Future Directions

In conclusion, our study found that all three high-level organizational factors we examined - communication, organizational climate, and tangible support - were important predictors of the radiology department's ability to conduct and interpret medical diagnostic examinations. Our results suggest that to improve the effectiveness of the department in conducting and interpreting these diagnostic examinations, especially in regard to communication with other hospital units and the tangible support needed to adequately perform medical diagnostic examinations, managers in the radiology department and of the hospital as a whole must focus their attention on process attributes or spans of control and burden. Future research could explore other more detailed attributes at the organizational level or examine differences among ratings of these attributes by the department's radiology managers, technologists, and physicians. Other difficult and complex issues are how to use these findings to practically improve the process and structure of the radiology department, how to reduce such problems in hospital performance, and how to close the gap between research and practice in the radiology department. In this context, the coordination of organizational attachment and professional role obligations will be important intervening variables in the intermediate affect model of the radiology department.

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فعالية قسم الأشعة في إجراء وتفسير الفحوصات التشخيصية الطبية مقدمة

يتمثل أحد المتطلبات المهمة للمستشفى الحديث في تحليل حالات مرضية معقدة واتخاذ قرارات بشأنها في إطار زمني قصير. تعتمد الاستراتيجيات لتحقيق هذا الهدف على ثلاثة عناصر متميزة ومتراصة: المعرفة الطبية، والتقنيات الطبية، والجسور الطبية. تتمتع هذه الاستراتيجيات، عند تطبيقها على الصور والطب، بالقدرة على تغيير عملية صنع القرار من قبل المتخصصين في الرعاية الصحية، لأنها توفر وصولاً أكثر تكاملاً ومتزامناً للبيانات، مما يؤدي إلى تقييم أكثر توقيتاً للحالة وتحسين رعاية المرضى. ويدعم هذه الحالة التي تقدمها بيئة الرعاية الصحية متخصصون مؤهلون قادرون بشكل أفضل على إجراء تحليل متعدد الوسائط على مستويات تعقيد عالية في فرق متعددة التخصصات.

يهدف مشروع البحث هذا إلى قياس فعالية قسم الأشعة في إجراء وتفسير الفحوصات التشخيصية الطبية. يقوم هذا القسم، من خلال نهج الفريق المتكامل، بتفعيل وتحسين استراتيجيات المعرفة الطبية الراسخة في نموذج الصور والطب. تسمح الجسور الطبية بتحسين تقنيات الحصول على الصور وتشخيصها والتنبؤ بالفعالية العلاجية، مما يتيح الوصول إلى البيانات بشكل أكثر تكاملاً ومتزامناً. توفر عملية صنع القرار من قبل المتخصصين في الرعاية الصحية تقييماً أكثر توقيتاً للحالة، مما يؤدي إلى رعاية أفضل للمرضى. يجب أن يأخذ تحقيق التحليل متعدد الوسائط مع الأداء على مستويات تعقيد عالية في الاعتبار المعايير الرئيسية للفعالية. يتعلق الأول بوقت الاستجابة لإصدار التقارير، والثاني هو تحليل لجودة الخدمة والتقارير التشخيصية.