Reducing Patient Waiting Time in Radiology: A Structural Equation Modelling Analysis

MARK M. ALIPIO
https://orcid.org/0000-0001-8360-0287
markalipiorrt@gmail.com
AMA University Online Education (AMA OEd)
Davao City, Philippines

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ABSTRACT

Short patient waiting time is an important marker of effective healthcare service delivery. However, radiology, a first-line diagnostic specialty, is currently challenged in providing prompt care to patients owing to the complexity of its administrative process and increasing patient demand. This study sought to develop a framework for reducing patient waiting time in radiology departments of 10 government hospitals in the Philippines. A total of 350 radiology patients in November 2019 participated, and survey questionnaires were used to elicit data. Using structural equation modeling, the study reported that healthcare providers' punctuality had the greatest impact on patient waiting time. Administrative processes completely mediate the effects of patient flow on patient waiting time; however, administrative processes partially mediate healthcare provider attitude on patient waiting time. Based on the developed framework, reducing patient waiting time in radiology can be achieved by increasing the punctuality of the healthcare providers, managing workers' attitudes, and administrative and patient workflow systems' efficiency.

Keywords — Health, patient waiting time, radiology, cross-sectional, Philippines

INTRODUCTION

Radiology departments play a vital role in the diagnosis and treatment of various pathological conditions. The diversity of services provided, such as but not limited to general x-ray, computed tomography (CT), nuclear medicine, radiation oncology, and cancer units, makes these departments a very complex system to run. To heed this complexity, maximum efficiency of imaging is paramount, particularly in the case of trauma and cancer, whereby patients often present with vague clinical history. The faster the procedures are performed on these patients, the quicker the diseases and other critical conditions can be identified, and the better the prognosis.

Despite this notion, there are problems concerning lengthy waiting times in the radiology departments. Targets proposed by both the government mandate of the National Health Service (NHS) Constitution and Independent Cancer Taskforce have increased pressure on departments to ensure patients wait no longer than 18 weeks from referral to non-emergency treatment (DOH, 2009). Moreover, a maximum 6-week target for any diagnostic test is imposed on those highly suspected of having cancer (DOH, 2009). However, recent NHS statistics from January 2017 highlight that 14,600 (1.7%) patients are currently required to wait longer than six weeks (England & Improvement, 2015), a figure above the operational standard of 1% (NHS England, 2017). Similar concerns have been raised in Denmark, where less than half of head and neck cancer patients are currently being treated in the required timeframe (Lyhne et al., 2013).

The Royal College of Radiologists (RCR) have raised their concerns regarding waiting times in the United Kingdom (UK) x-ray. They acknowledge the crucial role of x-ray in the diagnostic process with 23,054,170 x-rays performed during 2013–2014 (RCR, 2016), and highlight the pressures on departments from growing public expectation to deliver x-rays faster. Such expectation has resulted from the recent publication of delays in receiving radiology examinations and results, leading to prolonged diagnosis and treatment (RCR, 2016). A similar public expectation has been encountered in the US, where patients are expecting a swift diagnosis and where patients perceive immediate imaging and prompt diagnosis as their 'best treatment' (Larson, 2010). Patient-focus groups have found waiting times a key patient concern with regards to the quality of their care (Stokes, Spalluto, & Omary, 2016).

Other studies have also highlighted x-ray waiting times as directly affecting the patient's quality of care. Lyon and Reeves (2006) investigated reasons for high, 'did-not-attend' (DNA) rates in UK x-ray via a telephone questionnaire. Lengthy

waiting times to initial x-ray appointment were claimed to significantly increase DNA rates as the illness had either resolved or worsened to warrant attendance at the emergency department (ED). This issue has also been raised in a recent Australian study of ED attendance, where patients' reasoning for attending ED rather than the GP surgery was the respective waiting times to access these services (Unwin, Kinsman, & Rigby, 2016). Blomberg, Brulin, Andertun, and Rydh (2010) found lengthy waiting times in radiology to significantly impact patients' perceptions of quality of care in Sweden, following a cross-sectional study.

Moreover, longer waiting times pose a significant problem in many areas of medicine. Waiting times impact the quality of care, inconveniences the patient, increases the cost of care, and has material consequences on the medical issues the patient faces (Oostrom, Einav, & Finkelstein, 2017). A study by Byrne, Barrett, and Bhatia (2015) demonstrated the effect of wait times in patients with non-small cell lung cancer (NSCLC). Biopsies from patients in a Newfoundland center who required CT guided lung biopsies in 2009 were compared to biopsies taken in 2011 as there were significantly shorter wait times in 2011. The authors showed longer wait times correlated with an increase in the tumor size and stage found on imaging, which worsens the prognosis of NSCLC.

Similarly, Jensen, Nellemann, and Overgaard (2007) showed that wait times negatively impacted disease course in the context of head and neck cancers. In this cohort, the authors compared initial diagnostic scans with the treatment planning scan of patients diagnosed with head and neck cancer, and measured changes in tumor volume and disease stage. The average wait time was four weeks, with a range of 5 to 95 days, and most (62%) of the patients had an increase in tumor size. Many others developed severe tumor growth complications, including new lymph node metastases (20% of patients) and progression in the TMN classification (10% of patients).

Wait times have an economic impact as well. A report by Barua, Rovere, and Skinner (2010) estimated that 973,505 Canadians waited an average of 10.6 weeks to access treatments in 2016 and that on average each patient lost between $1,759 to $5,360, depending on whether the analysis only included loss of work hours or included loss of weekends and evenings as well. The total estimate borne by individuals waiting for treatment is between $1.7 billion or $5.2 billion. This total estimate from the report does not include the cost of loss of productivity in the family members of the patients, and also does not include mental anguish or worsening medical issues (Esmail, 2013).

In the Philippines and Indonesia, prompt care from medical specialists has been hampered because of long waiting times and inefficient appointment systems

(Dacanay & Rodolfo, 2005; Mardiah & Basri, 2013). This issue is primarily observed in the hospital emergency departments, including the radiology services, which are vital in alleviating the acute conditions of the patients. Previous reports mentioned that public hospitals in the Southeast Asian countries such as Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, are challenged to address the overcrowding issue as there is an upsurge in the number of patients from far-flung areas seeking medical care (Ahmad, Khairatul, & Farnaza, 2017; Conrad, 2013). The same reports mentioned that more than eight million die each year in the country. From this distribution, three out of five are due to poor-quality care, which includes inadequate medical consultation and long patient waiting times. Therefore, providing prompt access to critical medical services such as diagnostic radiology procedures is of paramount importance.

Several studies have been made to analyze the factors affecting patient waiting times in hospital departments, especially in the radiology area. The punctuality of healthcare providers was found to influence patient waiting time (Onwuzu, Ugwuja, & Adejoh, 2014). It was reported that the two most common factors leading to long waiting times in hospitals were poor patient flow, and negative healthcare provider attitudes (Rohleder et al., 2011; Oche & Adamu, 2013). However, the relationship between these variables remains inconclusive as previous studies reported that waiting times are significantly related to administrative processes (Jaakkimainen et al., 2014; Storm-Versloot et al., 2014). These administrative processes, in turn, were significant correlates of patient flow and attitudes of attending healthcare professionals (Johnson, & Russell, 2015; Naiker, FitzGerald, Dulhunty, & Rosemann, 2018). For instance, although patient waiting time is affected by patient flow management and healthcare provider attitudes, the administrative processes' efficiency is still the primary concern (Johnson, & Russell, 2015). Moreover, patient flow management and healthcare provider attitudes do not influence administrative processes when administrative processes are not organized (Naiker et al., 2018). The Queuing Theory in healthcare posited that delays in waiting in line are caused by various punctuality dimensions of healthcare providers and workflow management (Mehandiratta, 2011). It was also suggested that healthcare provider attitudes had a direct impact on patient waiting time (Mehandiratta, 2011).

Despite the various theoretical models of patient waiting time, a framework has not been formulated to analyze its underlying constructs. Also, there seems to be an inconclusive proposition about the relationship of the variables considered, which spurred the interest to test the mediation effect of administrative processes on the correlation of patient waiting time. Exploring the underlying dimensions

that affect patient waiting time is essential in the formulation of efficient queuing systems and monitoring of the quality of healthcare services provided to the patients. Given the need to continuously upgrade the workflow system in the hospital, especially in the radiology department where the patients seek most of the services, the necessity to provide immediate medical care to patients, and the rapid demand of healthcare services in the Philippines, a theoretical framework that identifies the factors affecting patient waiting and the relationships among these factors, is vital to develop.

FRAMEWORK

Based on the underlying constructs in the previous literature (Mehandiratta, 2011; Jaakkimainen et al., 2014; Onwuzu et al., 2014; Storm-Versloot et al., 2014; Johnson, & Russell, 2015; Naiker et al., 2018). A conceptual model is presented for patient waiting time in Figure 1. As shown, the constructs of healthcare provider attitudes and patient flow directly influence patient waiting time. These relationships are mediated by the construct of administrative processes, which has a direct influence on patient waiting time. The conceptual model also shows that the construct of punctuality of healthcare providers has a direct impact on patient waiting time.
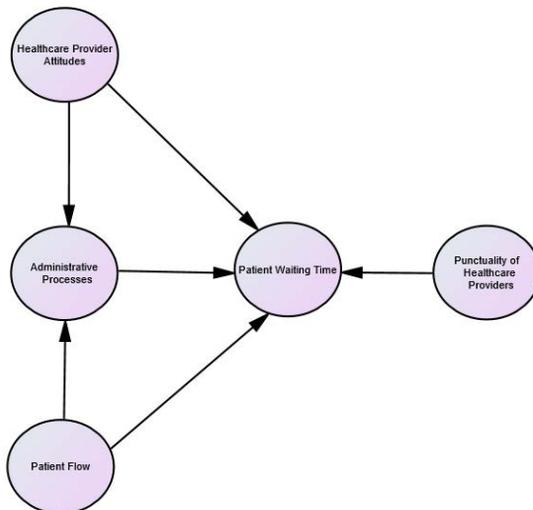

Figure 1. Conceptual Model of Patient Waiting Time

OBJECTIVES OF THE STUDY

The study aims to develop a framework for reducing patient waiting time in radiology based on the identified gaps and ambiguity in the dimensions of patient waiting time. Specifically, it aims to determine the magnitude of influence of healthcare provider attitudes and patient flow on administrative processes and patient waiting time and the extent of administrative processes and punctuality of healthcare providers' effects on patient waiting time. The study also aims to know if administrative processes mediate the relationships between healthcare provider attitudes and patient waiting time and between patient flow and patient waiting time.

METHODOLOGY

Research Design, Setting, and Respondents

The present study utilized a cross-sectional survey design in an attempt to explore the conceptual model of patient waiting time. This study was conducted in November 2019 in 10 public hospitals in Southern Philippines. Of the ten public hospitals, six were identified as Level 1, two were Level 2, and two were Level 3. The hospitals were selected based on the availability of radiology services. A total of 350 patients in the radiology department of the surveyed hospitals were conveniently sampled. A response rate of 100.0% was obtained after all of the study samples returned the questionnaire without missing data.

Measures

The constructs of healthcare provider attitudes, administrative processes, and patient flow were measured using the Service Quality Scale (Johnson & Russell, 2015). The healthcare provider attitudes dimension consisted of 10 items, while the dimensions of administrative processes and patient flow were both composed of seven items. The construct of punctuality of healthcare providers was measured using one item, "How punctual are the healthcare providers when you seek medical care from them?". Each of the items in the constructs was rated on a five-point Likert scale, with '5' being the highest and '1' being the lowest. The patient waiting time was measured based on the time in minutes a patient waits in a medical facility before being attended by healthcare providers for treatment or consultation. This time was computed by subtracting when the patient arrives in the radiology department from the time the healthcare provider attends the

same patients' needs. To account for the reliability of the tool, the questionnaire was pilot tested to 30 patients, and the results revealed that the instrument had adequate internal consistency (Cronbach alpha=0.921).

In compliance with the Declaration of Helsinki, the respondents were given informed consent before the administration of the survey questionnaire to the actual study sample. Written in the consent was the benefits of the respondents in participating in the study and associated risks. The respondents were fully aware that the questionnaire's answers will be used entirely for the investigation results. Moreover, they were given the autonomy to answer the items in the survey questionnaires. All of the answers and names of the respondents were treated with the utmost confidentiality.

Data Analysis

SPSS version 21 and AMOS version 23 software was used to analyze the collected data. Healthcare provider attitudes, administrative processes, patient flow, punctuality of healthcare provider, and patient waiting time were descriptively analyzed using mean and standard deviation (SD). With the conceptual model of the study, a Structural Equation Modeling (SEM) was conducted to determine the hypothesized relationships between healthcare provider attitudes, administrative processes, patient flow, punctuality of healthcare provider, and patient waiting time. SEM allows calculations of the regression coefficients and evaluation of total, direct, and indirect effects of correlated variables. Goodness-of-fit of the conceptual model was evaluated using Chi-square statistics, and root mean squared error of approximation (RMSEA), goodness-of-fit index (GFI), normal fit index (NFI), comparative fit index (CFI). To indicate a good model fit, the RMSEA should be close to zero, while the GFI, NFI, and CFI should be at least 0.95 (Hu & Bentler, 1999).

RESULTS AND DISCUSSION

Table 1 presents the mean, standard deviation (SD), and verbal description of the study variables. The healthcare provider attitudes variable obtained a mean score of 3.99 and SD of 0.42 with a descriptive equivalent of high. This result implies that the respondents are often satisfied with the accommodation, courtesy, and information given by the healthcare providers in the radiology department. The administrative processes variable obtained a mean score of 3.95 and SD of 0.41 with a descriptive equivalent of high. This result implies that

the respondents are often satisfied with the convenience of accessing healthcare services in the radiology department. The patient flow variable obtained a mean score of 4.00 and SD of 0.43 with a descriptive equivalent of high. This result implies that the respondents are often informed regarding their wait time before and after the medical care visit.

Previous studies noted the importance of positive healthcare provider attitudes in the holistic patient-centered treatment approach in health management (Chahal & Mehta, 2013; Naidu, 2009). The level of interpersonal skills, communication, courtesy, and empathy of the healthcare providers directly influences patients' satisfaction with the healthcare services given (Naidu, 2009). Moreover, the convenience, promptness, and accessibility of healthcare services merited exploration and were observed to affect the health-seeking behavior of the patients needing medical care (Russell, Johnson, & White, 2015).

The healthcare provider variable's punctuality obtained a mean score of 3.33 and SD of 1.39 with a descriptive equivalent of moderate. This result implies that the healthcare providers are sometimes punctual in delivering the healthcare services in the radiology department as perceived by the respondents. The punctuality of a healthcare worker is a sign of respect for the patient's time and professionalism (Azizam & Shamsuddin, 2015). In the practice of radiology, punctuality of radiation workers is essential because the information given by the diagnostic examinations such as general X-ray and computed tomography serves as a guide for other clinical departments such as orthopedics and internal medicine (e.g., surgeons ask for X-ray findings as a guide for the treatment of fractured bone); hence, timely and quick conduct of the procedures is warranted.

The mean patient waiting time in minutes was 89.31, with an SD of 50.40. This result implies that an average patient waits 89.31 minutes in the radiology department before being attended by a healthcare provider. This value is slightly higher compared to the waiting time in an outpatient department in a Nigerian tertiary hospital (Oche & Adamu, 2013) and general radiography department in Kenya (Muchuki, 2019) but lower compared to the general outpatient department of two hospitals in Ethiopia (Belayneh, Woldie, Berhanu, & Tamiru, 2017).

Table 1. Descriptive Statistics of Study Variables

Variables	Mean	SD	Verbal Description[a]
Healthcare provider attitudes	3.99	0.42	High
Administrative processes	3.95	0.41	High
Patient flow	4.00	0.43	High
Punctuality of healthcare provider	3.33	1.39	Moderate
Patient waiting time (minutes)	89.31	50.40	

Note. a=4.20-5.00=Very High; 3.40-4.19=High; 2.60-3.39=Moderate;
1.80-2.59=Low; 1.00-1.79=Very Low

The variables of the conceptual model obtained the following values: Chi-square statistics=75.508 ($p<0.001$, df=4), RMSEA=0.02, GFI=0.96, NFI=0.97, and CFI=0.96. All of the values satisfied the criteria of a good model fit (Table 2).

Table 2. Goodness of Fit Measures of Conceptual Model

Indices	Criterion	Model Fit Value
RMSEA	<0.05	0.02
GFI	>0.95	0.96
NFI	>0.95	0.97
CFI	>0.95	0.96

The results of the analysis of the conceptual model are shown in Figure 2. As shown, the following were statistically significant: patient waiting time paths in the punctuality of healthcare providers ($p<0.001$), healthcare provider attitudes ($p<0.001$), administrative processes ($p<0.001$), and patient flow ($p<0.001$); administrative paths in the healthcare provider attitudes ($p<0.001$) and patient flow ($p<0.001$).
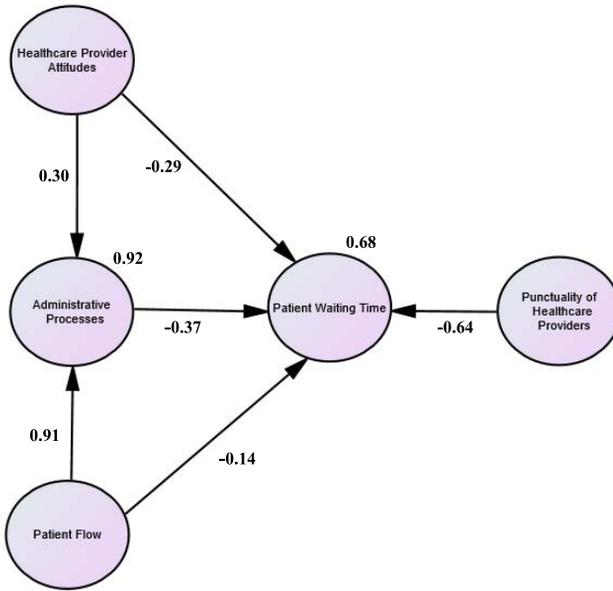
Figure 2. Path Diagram for the Conceptual Model

Table 3 shows the standardized direct effect estimates, standardized indirect effect estimates, standardized total effect estimates, and squared multiple correlations among the variables of the conceptual model. The patient flow had the highest direct effect on administrative processes as manifested by a path coefficient of 0.91, followed by healthcare provider attitudes with a path coefficient of 0.30. The direction of influence of patient flow and healthcare provider attitudes on administrative processes was positive which implies that when the patients are well informed regarding their wait time before and after the medical care visit and properly accommodated by the healthcare providers, they find ease and comfort in accessing healthcare services in the radiology department. These results are consistent with the previous studies. However, the surveyed departments were different, which reported that administrative processes were significant correlates of patient flow and attitudes of attending healthcare professionals (Johnson, & Russell, 2015; Naiker et al., 2018). In the radiology department context, the findings highlight the significance of organized patient flow systems and positive workers' attitudes to the attainment of convenient processing of patients' requests.

The healthcare provider's punctuality had the highest direct effect on patient waiting time, as manifested by a path coefficient of -0.64, followed by administrative processes with a path coefficient of -0.37. The direction of influence of punctuality of healthcare providers on patient waiting time was negative, which implies that when the patients perceive the healthcare providers as punctual in delivering healthcare services on time, they get the medical care from the health providers in shorter waiting time. Although the previous report focused on medical clinics, it concurred with the present study, which describes how healthcare providers' punctuality significantly influences patient waiting time (Onwuzu et al., 2014). Therefore, the role of punctuality in healthcare delivery should not be undermined because it has the most considerable influence on patient waiting time based on the analysis.

The patient flow had a direct effect on patient waiting time with a path coefficient of -0.14 and a total effect of -0.48 when added to the indirect effect of the administrative processes (-0.34). The healthcare provider attitudes had a direct on patient waiting time with a path coefficient of -0.29 and a total effect of -0.40 when added to the indirect effect of the administrative processes (-0.11). Patient flow and healthcare provider attitudes explained 92% of the administrative processes. In contrast, patient flow, healthcare provider attitudes, punctuality of healthcare provider, and administrative processes explained 68% of the patient waiting time variance. Because this is the first exploration of the conceptual model of patient waiting time in the Philippines, it was difficult to compare the present results with other literature. There is no existing structural model that could explain patient waiting time to the knowledge of the author. However, previous studies reported that the variance in patient waiting time could be explained by the punctuality of hospital staff, accessibility of healthcare services, and promptness of healthcare providers (Belayneh et al., 2017; Jaakkimainen et al., 2014; Onwuzu et al., 2014). Nevertheless, the present study showed that patient waiting time could be explicated by multiple variables associated with the healthcare provider and patient workflow management. This study emphasizes the importance of efficient patient flow and administrative processes, positive healthcare provider attitudes, and punctuality of workers on reducing the waiting times of the patients in radiology departments.

A mediation analysis was further conducted to test if administrative processes mediate the relationships between healthcare provider attitudes and patient waiting time, and between patient flow and patient waiting time. According to the results in Figure 2 and Table 3, patient flow, as an independent variable, affects the administrative processes (mediator), positively and significantly

(B=0.91, p<0.001). Without the administrative processes, patient flow negatively and significantly affects patient waiting time (B=-0.48, p<0.001). However, when the administrative processes variable is included in the model, it was found that patient flow has no significant direct effect on patient waiting time (B=-0.14, p>0.05). In contrast, administrative processes have a negative and significant effect on patient waiting time (B=-0.37, p<0.001). This result indicates that administrative processes completely mediate the effects of patient flow on patient waiting time. In other words, patient flow indirectly contributed via the administrative processes to explain the variation in patient waiting time.

The study suggests that patients who are well informed about their wait time and who experience efficient management during the given waiting times seem to experience convenience in accessing healthcare services from the radiology department, which might reduce their waiting time. For instance, efficient patient flow management does not affect patient waiting time without observing organized and timely administrative processes.

On the other hand, the healthcare provider attitude, as an independent variable, affects the administrative processes (mediator), positively and significantly (B=0.91, p<0.001). Without the administrative processes, the healthcare provider's attitude negatively and significantly affects patient waiting time (B=-0.29, p<0.001). When the administrative processes variable is included in the model, it was found that the healthcare provider attitude has a negative and significant direct effect on patient waiting time (B=-0.29, p>0.05). In contrast, administrative processes have a negative and significant effect on patient waiting time (B=-0.37, p<0.001). This finding indicates that administrative processes partially mediate the effects of healthcare provider attitude on patient waiting time. In other words, healthcare provider attitude contributes directly to explain the variation in patient waiting time and indirectly via the administrative processes. The study suggests that situations, where healthcare providers show positive work attitudes towards the patients, might lead to a systematic delivery of healthcare services, which in turn reduces the time the patients wait before being attended by healthcare providers.

Table 3. Maximum Likelihood Estimates of the Variables

Endogenous Variables	Exogenous Variables	Standardized Direct Effect	Standardized Indirect Effect	Standardized Total Effect	SMC
Administrative Processes	Patient flow	0.91***		0.91***	0.92
	Healthcare provider attitudes	0.30***		0.30***	
Patient Waiting Time	Patient flow	-0.14	-0.34***	-0.48***	0.68
	Healthcare provider attitudes	-0.29***	-0.11***	-0.40***	
	Punctuality of healthcare provider	-0.64***		-0.64***	
	Administrative processes	-0.37***		-0.37***	

Note. *** $p < 0.001$.

CONCLUSIONS

This study successfully developed a framework for reducing patient waiting time in radiology. Based on the structural framework, patient flow and healthcare provider attitudes explained 92% of the variance in the administrative processes, while patient flow, healthcare provider attitudes, punctuality of healthcare provider, and administrative processes explained 68% of the patient waiting time variance. The patient flow had the greatest direct effect on administrative processes, while punctuality of healthcare providers had the greatest direct effect on patient waiting time. The framework also depicted that administrative processes completely mediate the effects of patient flow on patient waiting time; however, administrative processes partially mediate the effects of healthcare provider attitude on patient waiting time. Finally, the framework showed that to reduce patient waiting time in radiology, punctuality of the healthcare providers should be increased, workers' attitudes should be managed, and the efficiency of the administrative and patient workflow systems should be improved.

Despite the results of the study, several limitations were noted for improvement. First, the study was cross-sectional, and the results were not generalizable to the population at different time points. A longitudinal study may be conducted to provide a more accurate analysis of the conceptual model. Second, the study was only limited to public hospitals in Southern Philippines, and the results are difficult to generalize the hospitals in other regions of the

country. Although the study noted several limitations, to the best of authors' knowledge, it is the first to explore the conceptual model of patient waiting time in radiology departments of public healthcare facilities in the Philippines. Moreover, it is the only study that provides empirical evidence on the mediating effect of administrative processes on the relationships between healthcare provider attitudes and patient waiting time and between patient flow and patient waiting time.

TRANSLATIONAL RESEARCH

Several implications are drawn based on the results of the study. Action plans should be developed and geared towards increasing the punctuality of the healthcare providers, managing workers' attitudes, and increasing the efficiency of the administrative and patient workflow systems, in order to reduce the waiting times of the patients in the radiology departments. In particular, quality assurance approaches should focus on improving the organization of administrative processes to substantially reduce the waiting times of the patients availing radiological services in the hospital. A continuous monitoring scheme for the punctuality of the healthcare providers should be dedicated to providing prompt healthcare services delivery to the patients.

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