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ORIGINAL RESEARCH

The process of requesting clinical tests in a reference university laboratory center

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Abstract

Background: Simultaneous with other countries, utilization of laboratory tests has increased in Iran. Since understanding the requesting behavior of doctors is a crucial matter, this study conducted in a university reference laboratory center, aiming to assess the process of requesting clinical tests.

Materials and Methods: This study was a descriptive cross-sectional study conducted using the census method on 231277 patients of a main referral polyclinic in Kerman. The data regarding the performed tests, the frequency of requesting laboratory tests, and the demographic information about the patients between 2008 and 2012 extracted from the information system of the laboratory. To analyze the data, SPSS 20 and descriptive statistics methods used.

Result: Most of the patients were women 16 to 50 years old, and had gone to the clinic only once. Most prescriptions had 50 to 100 tests. General physicians and internists had the highest share of orders and prescription costs. In accordance with rising medical expenses, the prices of laboratory services increased in each year.

Conclusion: This study showed that the 80/20 rule applies to prescriptions, since more than 80% of prescriptions made by only 20% of doctors. To change the behavior of requesting laboratory tests, we need to define accurate and tangible criteria for assessing the appropriateness of requesting in clinical guidelines.

Keywords: Rational requesting; Prescriptions; Laboratory.

Introduction

Currently, a large proportion of health service provision system consists of laboratories (1). 60-70% of the objective information in patient files related to laboratory information (2). According to an announcement made by the European Diagnostic Clusters Alliance, the costs of laboratory tests make up 0.8% of the total health expenses (3). Some researchers have reported a negative relation between the number of tests and the outcome of care. Therefore, clinical specialists need to know the side effects of inappropriate requesting (4).

A systematic review showed that health expenses have increased, both in relative and absolute modes (5). This increase was observed in many countries, and if continued, they will face instabilities in this matter (6). Since many tests seem to be unnecessary in such a way that some studies have proved that 95% of the performed tests requested based on fee for service criteria or to improve the quality of services and they had no appropriateness to the illness (7).

In addition to the financial expenses of diagnostic tests, understanding the requesting behavior of doctors, from both economic and clinical viewpoints, is important (8). Through reviewing the specialty of doctors and the requested tests and assessing the test results, it proved that to achieve purposeful writing of laboratory prescriptions, we can decrease the number of laboratory tests without imposing negative effects on patient care (9). Knowing the reasons for using too many tests, and developing some strategies to improve diagnostic test requesting behavior of doctors within the framework of utilization assessment programs is one of the main priorities of the health systems in all countries, especially in developing countries (10). A comprehensive review of evidence by the research team showed that no study has assessed the doctors' behavior of requesting laboratory diagnostic services in Iran. Therefore, the present study conducted in the main referral polyclinic, in a 5-year timespan, to assess the procedure of requesting laboratory diagnostic services by doctors in Kerman.

Materials and Methods

The present study is a descriptive cross-sectional study conducted using the census method on 231277 patients of the main referral polyclinic that is of great importance and gets wide coverage in Kerman due to its provision of super-specialty services and the high number of patients.

Here all the data related to tests performed in this polyclinic during the 2008-2012 timespan used. The data regarding the frequency of requesting laboratory tests and demographic variables of patients extracted from the information system of the laboratory of the polyclinic that is a relational database where the information of patients recorded in different tables, which also called relations.

Due to the large size of the data in the system there is an identification key for each record through which the records related to one another. As a result of technical problems in using large banks, the necessity of preparing the data prior to any use, issues such as missing values, errors in entering the data, and existence of outliers, the pre-processing of the data by an expert in computer science pre-processes was necessary. In this process, more than 11 million output longitudinal data of the SQL database turned into transverse data analyzable in Excel and SPSS. Afterwards, incomplete records, such as the cases in which the test result or the specialty of the related doctor not recorded excluded. In the end, 231277 records studied.

To integrate and transmit the data, create new fields from the previous ones, and edit the data using other information banks, the data must become uniform. The data assimilated in this stage included the time of admission (day/month/year), age(categorized in 4 groups: under 5 years old, 6-15, 16-50, and over 50), the doctor's work experience (less than 5 years, 5-10, 10-15, and 16-20 years), the specialty(codes allocated to 40 medical specialties, and due to the diversity, similar groups merged, and finally 22 groups used). Moreover, these 22 divided into 5 major groups of internists, surgeons, gynecologists, pediatricians, and other specialties. The groups of infectious disease specialists and radiologists excluded from the information bank, due to extensive information deficiency, the codes of tests(translating the titles of the tests into English and connecting the codes to the titles), the frequency of each test (grouping the number of the tests based on each specialist), and the status of the tests (after consulting a laboratory science specialist, the

normality or abnormality of the results determined and they categorized). Afterwards, we defined 400 kinds of functions in SQL, and these data entered into the databank and organized. Based on the kind of analysis in progress, the 22- or 5-fold grouping used.

There are 5 categories in the database for the patients of the clinic. The first category includes individual information of the patients (identification code, age, insurance, and gender), the second category includes the services provided by the clinic (titles of the laboratory, pharmacy, radiology, etc.), the third category includes the specialists, the fourth category includes the titles of the tests for each patient (insurance and patient contribution), and the fifth category includes the test results for each patient.

To analyze the data, SPSS 20 and descriptive statistics methods such as mean and frequency indices were used, needless to mention that to protect the privacy of the people, information related to identification, contact, and address, and other information which might lead to the identification of the patients were not included in the study.

The 40 specialties in the database: Gastroenterology, Orthopedics, Oral & Maxillofacial, Radiology, Cardiology, Gynecology, Anesthesiology, Neurology, Surgery, Dentistry, Pediatrics, Nephrology, Nuclear Medicine, otorhinolaryngology, General Surgery, Endocrinology, Internal Medicine Gastroenterology, Neonatology, Internal, Endocrinology internal, Midwifery, Psychiatry, Oncology, General practitioner, Dermatology, Infectious disease, Neurosurgeon Surgeon, Optometry, Internal Neurology, Urology, Radiotherapy – Oncology, Pulmonology, Super Specialist Plastic and Reconstructive Surgery and Burn, Physicist and Rehabilitation, Surgical Specialist Cardiology, Fellowship Specialized Liver Transplant, Hand Surgery, Occupational Medicine, Rheumatology and Psychology.

Merging the groups into 22 groups of specialties in the database: Internal Medicine Gastroenterology, Endocrinology, Urology, Internal, Pulmonology, Dermatology, Rheumatology, Physicist and Rehabilitation, Dentistry, Oncology, Pediatrics, Orthopedics, Gynecology, Neurology, General practitioner, Internal Neurology, General Surgery, Optometry, Otorhinolaryngology, Nuclear Medicine, Cardiology and Anesthesiology.

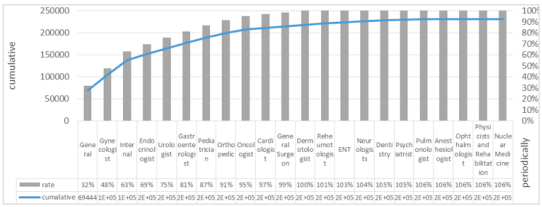
Results

The majority of the patients were women (71.81%), who were 16-50 years old (68.48%), and visited the clinic for the first time (85.96%). Also most of the prescriptions had 50 to 100 tests (37.98%). The demographic information of the patients visiting the clinic during the 2008-2012 time span presented in table 1.

Table 1: Demographic information of the patients visiting main referral polyclinic between 2008 and 2012

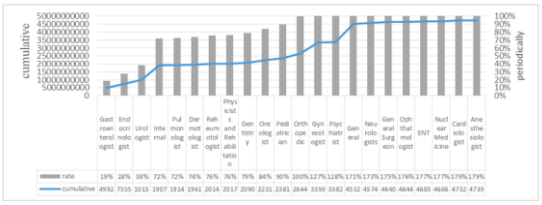
Demographic variables		Number	Percent
Age	< 5 years	11243	4.86%
	6-15	11963	5.17%
	16-50	158400	68.49%
	> 50	49671	21.48%
Gender	Female	166089	71.81%
	Male	65188	28.19%
Number of visits	1	198807	85.96%
	2	21534	9.31%
	3	6162	2.66%
	More than 4	4774	2.06%
Number of items	1-5	50177	21.70%
	6- 10	16358	7.07%
	10-50	75088	32.47%
	50-100	87842	37.98%
	>100	1812	0.78%

The study also showed that among the 22 specialist groups of the polyclinic, general physicians had the highest share of the prescriptions, followed by gynecologists, internists, and endocrinologists. As understood from the following graph 1, 69% of the highest number of prescriptions belongs to general physicians, gynecologists, and endocrinologists.



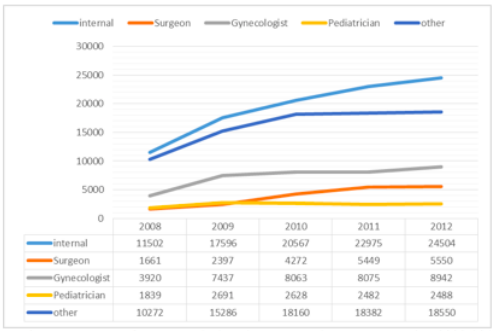
Graph 1: The cumulative bar graph of the number of prescriptions in each specialty group between 2008 and 2012

The findings of the study revealed that among the 22 specialist groups of the polyclinic, the highest expenses related to the general internists group, followed by general physicians, gynecologists and orthopedists (graph 2). As presented in graph 2, 72% of the highest prescription costs attributed to gastroenterology, endocrinology, urology, and internal medicine.



Graph 2: The cumulative bar graph of prescription costs in each specialty group between 2008 and 2012

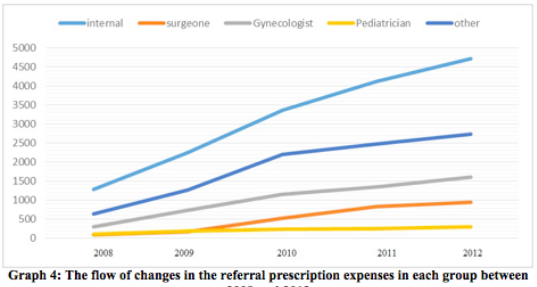
The findings showed that among the 5 specialty groups of the clinic, the number of prescriptions in different medical groups showed an upward trend during the 5-year time span of the study. The highest increase observed in the internists group and the lowest, in the group including other specialties. The number of prescriptions has more than doubled in the internal medicine group, while this index has remained almost unaltered in the pediatric group. After the internal medicine group, the highest increase in the number of tests attributed to the other specialties group, gynecologists, and surgeons (Graph 3).



	2008	2009	2010	2011	2012
internal	11502	17596	20567	22975	24504
Surgeon	1661	2397	4272	5449	5550
Gynecologist	3920	7437	8063	8075	8942
Pediatrician	1839	2691	2628	2482	2488
other	10272	15286	18160	18382	18550

Graph 3: The number of the prescriptions in each specialty group during 2008-2012

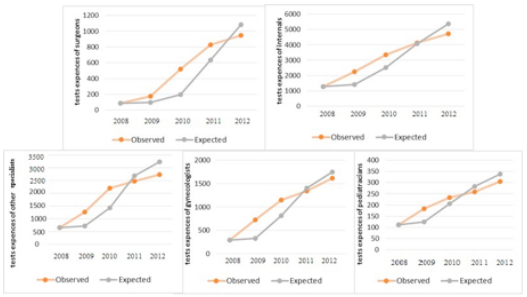
Among the 5 specialty groups of the clinic, the most changes in prescription expenses during the 5-year time span occurred in the internal medicine group. After this group, the other specialties group, gynecologists, surgeons and pediatricians had the greatest changes, respectively. Graph 4 demonstrates the rising trend in the prescription expenses of each specialty group (Graph 4).



Graph 4: The flow of changes in the referral prescription expenses in each group between 2008 and 2012

The study showed that changes in the mean of expenses of the referral prescriptions in each of the 5 groups had an increasing pattern. After the internal medicine group, gynecology, surgery, others, and pediatrics had the highest rates of change. The internal medicine group showed the highest rates of change, while the pediatrics groups had the lowest rates.

Considering the effect of the general inflation index on health expenses, the expected changes in expenses due to inflation in different years estimated in a secondary analysis. The comparison of the expenses of tests requested by the specialists of the polyclinic, with regard to the inflation announced by the Central Bank website, showed that every year, in accordance with the increases in medical tariffs, the expenses of laboratory services have also increased. Since 2010, this correlation has changed, and the inflation-related growth of laboratory expenses was smaller than expected.



Graph 5: Comparison of expenses of the tests ordered by specialists, based on the inflation reported on the Central Bank website

To analyze the relation between the increase in expenses and the general inflation rate, the expected increase in expenses due to the general inflation rate has been estimated. As seen in the graph related to the expenses of the surgery group in 2009, 2010, and 2011, the increase in the prescription costs of this group was larger than the expected inflation-related increase in expenses. However, in 2012, the increase in the inflation rate overtook the increase in the expenses of the prescriptions related to the surgery group. This means that the increase in the expenses of the prescriptions in the surgery group was larger than the increase in the inflation rate in the society, from 2009 to 2011. Although the graph demonstrating the changes in the expenses of the prescriptions in the surgery group has had an increasing trend during the 5-year span, considering the effect of the general inflation on prices of medical expenses during the years that were under assessment, a high proportion of these increases in expenses can be attributed to inflation. In 2011, the increase in expenses was completely in accordance

with the inflation rate. In groups of gynecology, pediatrics and other specialties, during the 5-year span, the laboratory service expenses show an increasing trend up to 2010, but after that, they decreased.

The findings showed that among the 5 specialty groups of the clinic, the number of prescriptions in different medical groups indicated an upward trend during the 5-year timespan of the study. The highest increase observed in the internists group and the lowest, in the group including other specialties. The number of prescriptions has more than doubled in the internal medicine group while this index has remained almost unaltered in the pediatrics. After the internal medicine group, the highest increase in the number of tests attributed to gynecologists and surgeons.

According to the study, the mean of the number of tests showed some fluctuations during the 5-year span, preventing us from drawing conclusions about the mean of the number of tests in different years. However, we can declare that the number of tests in the prescriptions in the pediatrics and other specialties remained almost constant during the studied period. Also, the gynecology group showed an increasing trend while the internal medicine and surgery groups showed a downward one.

Discussion

Studies have shown that women use health care services more than men do (11). A study in the Netherlands showed that there are significant differences in morbidity, use of health care services, and mortality rates between women and men, and that this might be due to the fact that women suffer from more illnesses than men do (12). Some believe that reasons for women's visits to receive health care services, which leads to their being considered the more commonly ill sex, include risks which they face and their different life style, understanding of symptoms, assessment of the importance of the symptoms, and desire to overcome their concerns about the illness (13). Hence, women are more concerned about their health and are more attentive.

Aging population expansion, defensive medicine, lack of transparent guidelines are among the factors increasing the demand for laboratory tests. It seems that educating the doctors and introducing laboratory regulations to limit the number of laboratory tests are the core of these plans. Giving feedback to all of the doctors based on their test requesting behaviors and the number of the requested tests compared to their other colleagues has been recently proposed as a new method for solving the problem. The habit of requesting laboratory tests originates from the convention that doctors do what is best for their patients; laboratory specialists are trying to prove that this general aim is achievable by using the best evidence based on laboratory tests, considering both diagnostic and analytic aspects (14). Of course, it needs to be mentioned that if only one visit to the laboratory is reported for most of the patients, the system must have been recording the information since 2007, and the information related to the years before that time was not recorded in the information system of the laboratory. Nonetheless, it seems that devising clear strategies and utilizing innovation as the guideline for medical orders to avoid unnecessary tests can be effective.

The findings of the study showed that a major proportion of the requested tests is related to the general physicians (among the 21 groups) and internists (among the 5 main groups of the study). The number of the tests requested by General physicians of the Netherlands was 998 on average, which was significantly different across different regions (15). Vegting, in a study conducted on the VU medical center in the Netherlands, showed that the high number of laboratory tests in the internal medicine group is due to the presence of young and unexperienced residents for surveying the number of unnecessary tests, and that about 30% of the tests related to the internal medicine group are unnecessary (16). The economic impact of extra tests has been combined with the 5-8% annual increase in the workload in many laboratories while the budget has not increased accordingly (17). It seems that, considering the numerous and ambiguous medical protocols, we need to devise accurate and objective criteria for assessing the appropriateness of orders in medical protocols, in order to alter the test requesting behavior of general physicians, who are an important part of the health system, as well as that of internists.

The internal medicine group specialists had referred the highest number patients for clinical tests, thus having created the highest laboratory service expenses. During the 5-year time span of the study, the number of prescriptions in all clinical groups had an increasing trend, and in this part of the analysis, the highest increase was related to the internal medicine group. After the internal medicine group, the highest increases in the number of tests attributed to the gynecologists, surgeons, and pediatricians. The analysis showed that the Pareto principle or the 80/20 rule applies to the field of writing prescriptions since more than 80% of the prescriptions written by only 20% of the doctors. However, the findings of a study showed that nearly two-thirds of the laboratory tests requested by the specialists of the internal medicine group could be avoided without having any detrimental consequences for the patients (18). Studies in other countries (Australia, America, Thailand) showed that after the internal medicine group, pediatrics, surgery and emergency medicine had the highest number of unnecessary tests. Several factors were effective on how much laboratory tests used. None of the medical groups were entirely responsible for the excessive use of laboratory services, there was no significant difference between the groups in this regard, and no information was achieved regarding any specific group (19). Some evidence showed that the efforts made to control the requesting behavior are not so effective, and to control the requesting of laboratory services, first the insurance companies and then the laboratories need to be responsible for checking the consistency of prescriptions with the medical protocols. Moreover, proper educational policies in universities and re-education programs for doctors after their graduation can decrease the number of tests.

The reasons for increasing requesting diagnostic tests are not properly understood, and probably, some complicated factors are effective in this regard. One of these factors might be the development of modern medical diagnostic technology. Also, fear of patient prosecution, and unawareness of using appropriate tests can be considered as other factors. Improving the quality of diagnostic test requesting requires an accurate knowledge of determining factors of requesting behaviors. Previous studies on the determining factors of diagnostic test requesting have had different findings. Various professional factors such as doctor age, records, risk taking, working experience, and specialty have been identified, none of which independently showed a significant effective share in the studies. Medical sciences, changes in medical organizations, health service providers, and patients are effective on the number and type of the tests. Reviewing past studies showed 5 key factors effective in requesting laboratory tests, including diagnostic, therapeutic and predictive factors, factors related to patients and doctors, and organizational and political factors (20).

One study showed that female doctors, doctors in urban medical centers, and doctors with heavy workloads requested more laboratory tests (21). Differences in medical diagnostic laboratory test requesting exist in many countries. A systematic review study showed that laboratories assessed the effect of 12 interventions on doctors with different specialties to improve the rational requesting of laboratory tests. These interventions include test expenses feedback, financial and capital controls, omitting the test from the medical diagnostic tests request form, suggesting clinical protocols, using appropriate laboratory tests in some cases, monopolizing advanced tests, appointing some people for requesting certain tests, determining the number of times and the reasons why a test is performed, performing reflexive tests to prevent the doctors from taking quick measures, granting doctors access to the results of patients' previous tests, reminders and warnings, and decision support systems (22).

The present study showed that in the aforementioned period, prescription costs increased in all diagnostic groups. Other studies also pointed at the increase in laboratory expenses in recent years (23, 24). Annually, in accordance with the increase in medical tariffs, the expenses of providing laboratory services increase too – an increase inevitable due to the increase in the prices of medical kits (diagnostic devices) and other economic problems of laboratories (25). Despite the rising trend in the laboratory service expenses during the 5-year span, considering the effect of the general inflation on medical expenses in these years shows that

a high proportion of increasing expenses is influenced by the general inflation rate.

This study showed that the Pareto principle is applicable to prescription writing since more than 80% of prescriptions have been written by only 20% of the doctors. Both indices of number and expenses of laboratory prescriptions had an increasing trend in the 5-year timespan. Given that this increase mentioned in other studies, and factors such as development of laboratory technology, higher accessibility of these technologies, and dependence of doctors on these technologies have been stated as reasons for it, we can link the increase in the number and items of prescriptions to these factors. On the other hand, some experts in our country see the induced demand or the commercial connection between the doctors and laboratory owners as the main reasons for the increase in requesting laboratory services. Since the study has been conducted in a government laboratory center, and there is no evidence proving the relation between the increase in prescribed items and doctors' income, it seems that defects in the guidelines of reasonable requesting of laboratory services and other factors such as defensive medicine and doctors' concerns about not having an exact and timely diagnosis and, consequently, legal prosecution by patients, insistence of some patients on persuading the doctors to order more tests, and, finally, doctors' benevolence and tendency to use modern technologies to provide better and safer services for the patients, along with international trends which have emphasized the place of laboratory tests in diagnosis, are all effective factors in increasing the number of tests. Also the study showed that although the expenses of laboratory services have had an increasing trend, this increase has been proportionate to or, even in some years, lower than the increase in the general inflation rate.

Main referral polyclinic, established in 2007, is the largest and most equipped laboratory center in the southeast of Iran, and therefore only the data regarding the years after this year are properly recorded and analyzable. However, due to the use of different information management systems, only the period between 2007 and 2012 was included in the study. According to the extensive research done by the researchers, the present is the first study on the patterns of requesting clinical tests and their expenses in a reference laboratory center in the country. Therefore, it can clarify many aspects of management and implementation so that the implementation challenges can be overcome to a high extent.

It is recommendable that in future studies, the fundamental factors of doctors' requesting behaviors be identified through causal layer analysis, and strategies be proposed to alter their behaviors.

Conflict of interest

Authors declare no conflict of interest.

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