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COLLEGE OF HEALTH SCIENCE

TEST UTILIZATION PRACTICES IN HAMAD MEDICAL CORPORATION:

LABORATORIES AND CLINICIANS

BY

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ABSTRACT

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Title: Test Utilization Practices in Hamad Medical Corporation: Laboratories and Clinicians

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Background Improper test utilization is a common problem of all healthcare systems. It costs vast amount of money without improving the patient care. There are three types of this inappropriate utilization of laboratory test including overused, underused and misused. One can result in another. In developed countries, like the USA, are trying to minimize such problem with many tools and technologies. The goals of this project are to (i) Identify laboratories' tests that are improperly utilized, (ii) investigate the laboratories' actions toward such test utilization practices, (iii) identify reasons affect physicians' decisions in ordering lab tests, and (iv) establish a future background for more specific investigations of test. Materials and methods: Two different types of online surveys, each was 10-15 minutes, had been distributed to laboratory supervisors and physicians at Hamad Medical Corporation (HMC). More information was acquired through three different personal interviews; one with the director of the laboratory service and two with laboratory supervisors. Results: Fourteen laboratory supervisors and eighty-eight physicians had been surveyed. This study showed that the supervisors were not getting the right supportive educational courses about best practice to manage the laboratory of laboratory test utilization management. Moreover, the communications between the physicians and the laboratories were very weak and not systemized. In addition, 14 types of improperly utilized tests had been identified. Numerous factors are affecting physicians ordering pattern.

When ordering a test, 59% physicians were not alerted about the redundant tests. While 78.4% participated physicians were using the clinical guidelines, surprisingly, 73% were not using the laboratory handbook, and 9.1% stated it is not useful. All physicians were asking their colleagues about the right laboratory tests to be ordered. Whereas 84% of physicians prefer to get feedback about an appropriate practice, 51% were not receiving any feedback, and 40.1% got them rarely. Many physicians (67%) were not aware of the cost of testing, and many of them (63%) showed their readiness to reduce their test orders if they were expensive. Conclusion: This is the first study about lab test utilization conducted at HMC and is providing a future background for further specific investigations. Most of the laboratory supervisors did not receive any training about best practice of laboratory utilization. Improper utilization of laboratory tests like HbA1c, vitamin D, and genetic testing had been showed by our study and evidenced by others. In order to request the appropriate test for their patients, physicians should be given regular feedback and encouraged to use laboratory handbook. At the time of ordering lab tests, alerts including previous test results and cost were preferred by many physicians and could affect their decisions. Pathologists interpretations should be reviewed and written in a way that provides most effective guidance to the physicians to order the right test or laboratory service. This study showed a great need for a culture change to be established by senior physicians and supervisors to ensure appropriate test utilization. Countless factors are causing inappropriate test utilization practices, yet many to be discovered with in-depth inquiries of each laboratory with the goal to reduce costs and improve overall processes.

Keywords: Test Utilization, Laboratory Supervisors, Physicians, Specialists, Improper practice, Hamad Medical Corporation, Overused, Underused, Misused

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1. INTRODUCTION

In the USA, healthcare industry costs are almost \$2.5 trillion per year, and pathology and laboratory testing acquire 4% of the cost or 60\$ billion. More than any medical field expenditures, the pathology and laboratory spending is increasing by 20-25% each year. Of course, this rapid growth is attributable to molecular and genetic genetics tests and services (1). Therefore, instead of raising the economic state of the country, the return on investment is miserably low. Henceforth, the overall goal of healthcare organizations should be to provide high-quality care while minimizing expenditures and improving processes (2).

To provide optimal patient care, the laboratory processes should be accurate and efficient starting from the test selection criteria provided in the lab handbook (contain tests provided by a lab and their indications), receiving an order, collecting and transporting the sample, processing and analyzing, and finally result reporting. This much work keeps the laboratory busy to involve more in the test selection process of the physicians, and without their support, the physicians will face an enormous pile of tests to choose the proper assay. Hence, physicians hardly come up with new tests outdoor their specialty and are expected to order many tests that may cause more harm than benefit the patient or fail to order the required tests resulting in delayed or wrong diagnosis (3).

Costs and outcomes of improper test utilization are clear enough to encourage investigating the reasons for such practice to boost the management of healthcare. In some laboratories, quick processing is a must, so the test utilization should be proficiently managed before receiving a sample. This will ensure the right test for the right patient and prevent subsequent unnecessary sample collection and testing (4). Many tools are available

to control test utilization at the time of placing the order (5,6). Nevertheless, there are no constraints to order a test repeatedly, and the likelihood it will be ordered indefinitely raises the incidence of unrequired tests (6, 7). As evidence, the US laboratories processed 4 billion tests in 1982, and this amount approximately doubled to reach 9 billion tests in 1993. With the many tests invading the markets, especially molecular diagnostics, countless of tests are being overused every day, and this demands a robust system to prevent such improper practice (1, 2). Overutilization of some tests had created other types of inappropriate laboratory test utilization (mis- and under-utilization) that entails to the healthcare costs (8). To elaborate, overused tests are those tests ordered redundantly and may harm the patient, while underused tests are the results of overused ones. Misused tests are those tests ordered with no medical indications for the clinical condition of the patient (2). Moreover, overused tests and misused tests may result in false positive or false negative cases (8).

We can say that healthcare monarchs are the physicians as they control 80% of its costs through examination, diagnosis, treating and following-up patients (8). Consequently, they are the real purchasers of healthcare services and exercise more power than imagined (14). Unfortunately, 50% of the tests are being ordered with no attention to the costs (9). Some studies had pointed out that the costs of diagnostic test account for 25% of overall healthcare system costs (10-11). Most of the expenditures of such systems are due to simple routine tests; nonetheless, much attention is given to expensive and high-tech tests (9). Unexpectedly and despite the presence of clinical practice guidelines to streamline the processes, the variability between physicians is estimated to be more than 17-fold when ordering tests for the same diagnosis (13,14). This indicates that such guidelines or test required criteria provided by the laboratory are not clear. Many factors that affect test

ordering pattern of any physicians and these are divided into evidence-based medicine (EBM) and non-evidence medicine (non-EBM). EBM is an “evidence-based approach toward therapeutic interventions and diagnostic processes.” Meanwhile, non-EBM includes two types of factors; 1. non-modifiable: like age, sex, location, practice setting, and specialization of a physician, 2. modifiable: as experience, knowledge, fear of malpractice, financial incentives, cost awareness, education and feedback (15). The greatest discrepancy between physicians’ medical practice had been found between different areas within the United States. Obviously, this is because of non-evidence based medicine behaviors due to the diverse population, the environmental conditions, and other factors. (16). A study showed that 30% to 50% of the laboratory tests are redundant and there was no association that more testing improves the patient outcomes (15,17). Another study has revealed that redundant test orders were a product of different physician practice style with no evidence of improving the patient care (18).

As a result, many considerations should be poured into the development of appropriate management systems to choose the right test for the right patient at the right time. This will require different criteria for each test and should highlight the type of test, the patient’s clinical condition and how frequently the biomarkers changes (4). The common term for such a comprehensive system is called Test utilization management. It can be defined as a system to reduce costs and improve care through encompasses a wide-range of tools and approaches to correct the consumption of laboratory tests (2).

Besides the absence of published studies, Hamad Medical Corporation (HMC) laboratory service manager had stated that there is no study in Qatar regarding test utilization practices although it is so evident that the problem of inappropriate practices

exists. By surveying laboratory supervisors and clinicians at Hamad Medical Corporation about the test utilization practice, the current study identified laboratories' tests that were improperly utilized and investigated the laboratories' actions toward such test utilization practices. Additionally, the survey identified reasons they could affect physicians' decisions in ordering lab tests and established a future background for more specific investigations of the test. This will help in overall process improvement and establish a future background for more specific investigations of test utilization.

2. METHOD

2.1. Participants:

Hamad Medical Corporation's laboratory supervisors and physicians were recruited. The total number was 102 respondents; 14 laboratory supervisors and 88 physicians. Three interviews had been conducted; one with HMC laboratory service manager and two with laboratory supervisors to ask about test utilization and other practices at HMC.

2.2. Materials and procedures:

Two ethical approval had been received for this research; one from Qatar University Institutional Review Board and the other from Hamad Medical Corporation Research Center for Review. Two different types of the anonymous survey had been sent by email; one to the laboratory supervisors and the other to the physicians. Each survey took 10-15 minutes to be completed. Complete voluntary participation was stated in the survey introduction, and anyone can stop at any time during the survey. The survey questions had been extracted from research articles and reviews. The Laboratory Supervisor survey had been categorized into areas of interest including demographics, laboratory role, test utilization malpractices and effect of improper test utilization. The physician's survey was also categorized into specific areas including demographics, current software, and its properties, available information sources, others' inquiries, assessments and involvement, test outcome/results, the cost of testing and other factors. Both surveys developed as online surveys using eXplorance Blue Survey software

provided by Qatar University. A 10 minutes lecture had been given to the laboratory supervisors to highlight the importance of this study. Then, the laboratory supervisors survey was circulated by the Department of Laboratory Medicine and Pathology (DLMP) at HMC, and two reminders had been sent to encourage doing the survey. Meanwhile, the physician survey was sent individually to some physicians and sent through heads of medical departments. The surveying process started from March 2017 to April 2017 to gain the maximum response count. Data analysis was done using IBM SPSS statistics 24 for Windows and Excel 2016. Categorical data are presented as percentages of frequency.

3. RESULTS

The total number of 14 laboratory supervisors and 88 physicians and specialists were surveyed.

3.1. Laboratory supervisors:

3.1.1. Demographics:

3.1.1.1. Age group:

The most frequent age group among this population were 40-49 years with a percentage of 50 (n=7 responses), followed by age group of 30-39 years that had a percentage of 42.86 (n=6 responses). Only one supervisor was above 50 years (7.14%), and no one at the age group of 20-29 was involved (Figure1).

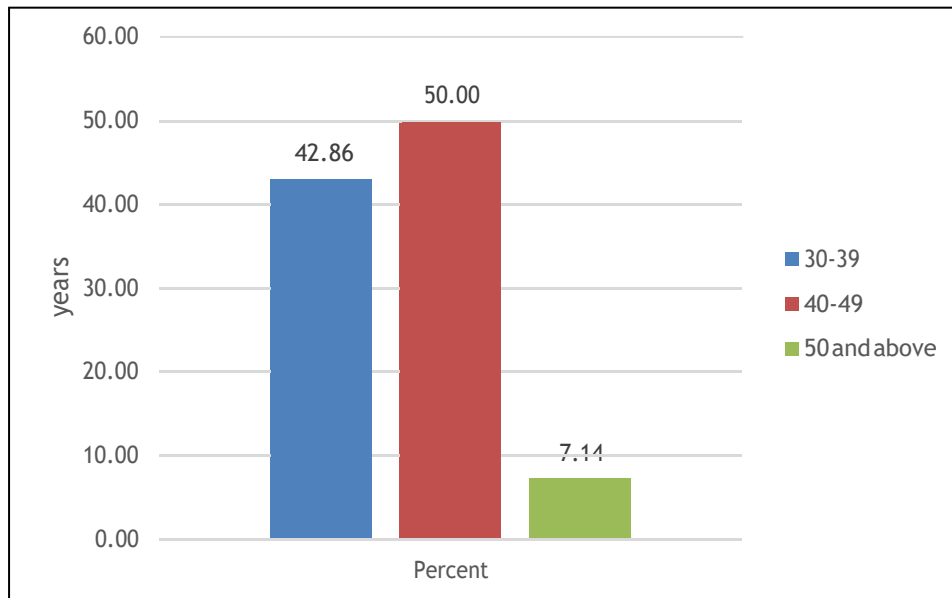


Figure 1. The percentage of the age group of laboratory supervisors

3.1.1.2. Highest qualification, Specialty and Length of time working as a laboratory technologist:

Of the 14 supervisors, 7(50%) had a Bachelor’s degree of Science (BSc), 5(35.71%) had Master’s degree of Science, and 2 (14.29%) had a Ph.D. degree (Figure2). 11 (78.57%) of the participants had biomedical sciences bachelor’s degree, 2(14.29%) had bachelor’s degree in both biomedical sciences and laboratory management degree, and one supervisor (7.14%) got a degree in Hematopathology (Figure3). Half of the supervisors (50%) got their educational degree from Qatar, and the other half (50%) got their degrees outside the country (Figure4). Most of the supervisors (11 individuals, 78.57%) worked as a technologist for more than 10 years, while 3(21.43%) used to work for (3-10) years (Figure5).

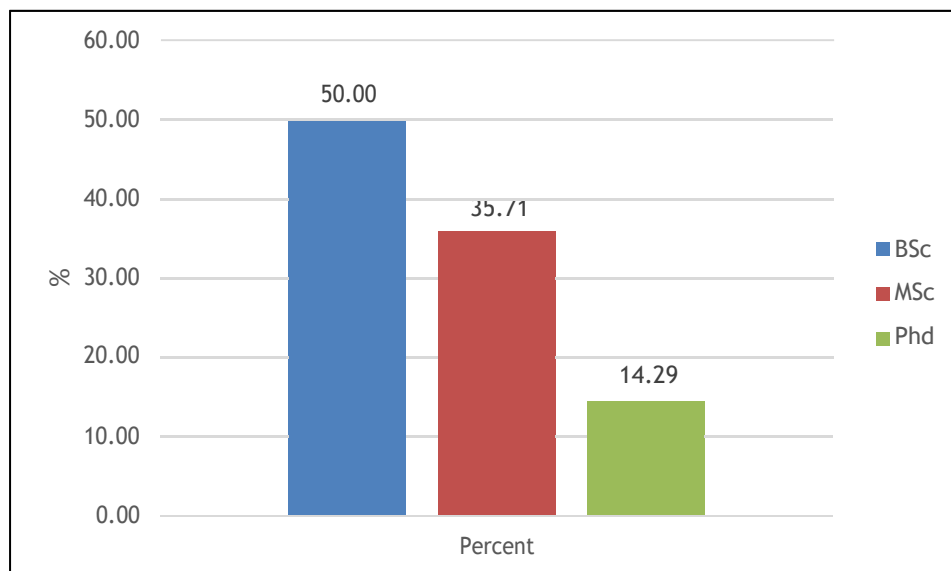


Figure 2. The percentage of the highest qualification of laboratory supervisors

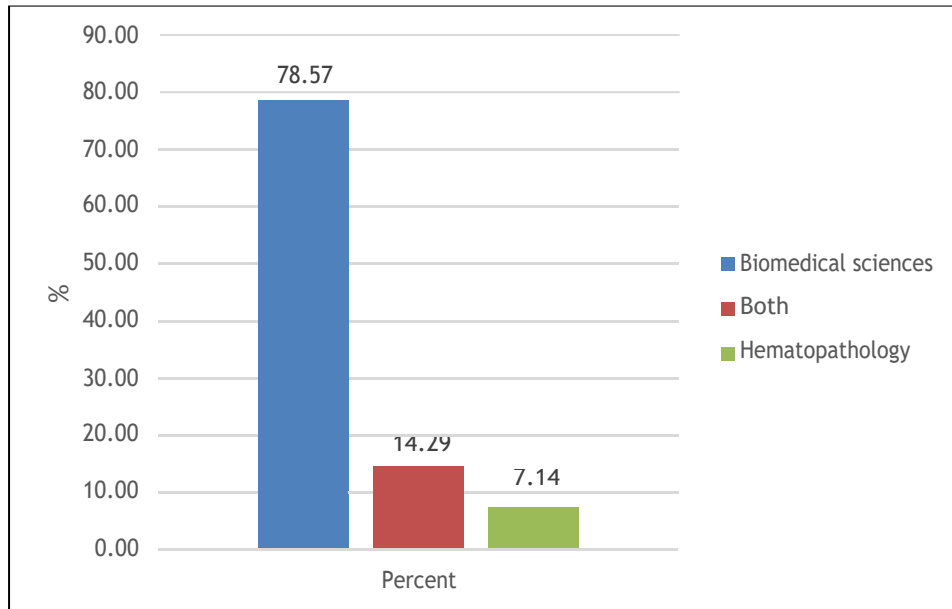


Figure 3. The percentage of the educational degree type of laboratory supervisors

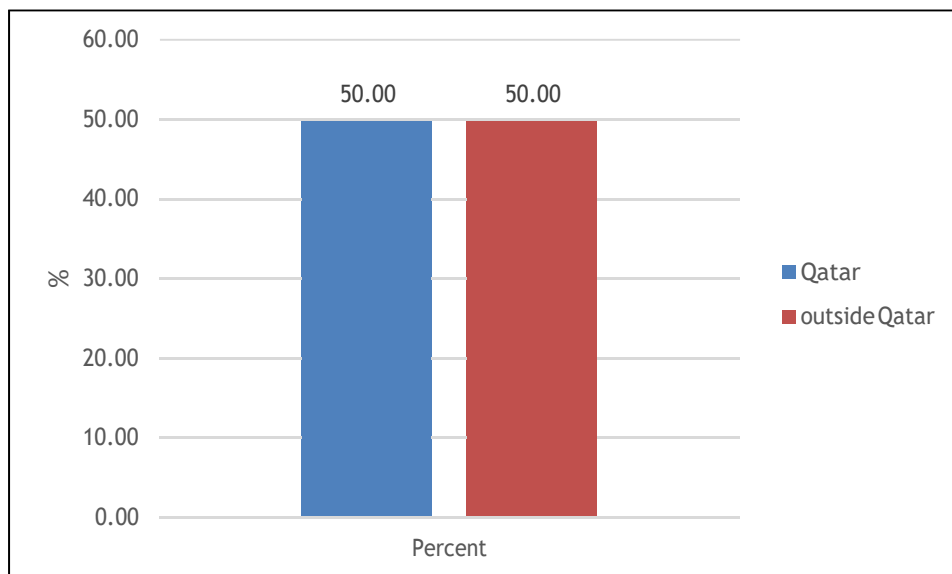


Figure 4. The percentage of the country where highest degree obtained for laboratory supervisors

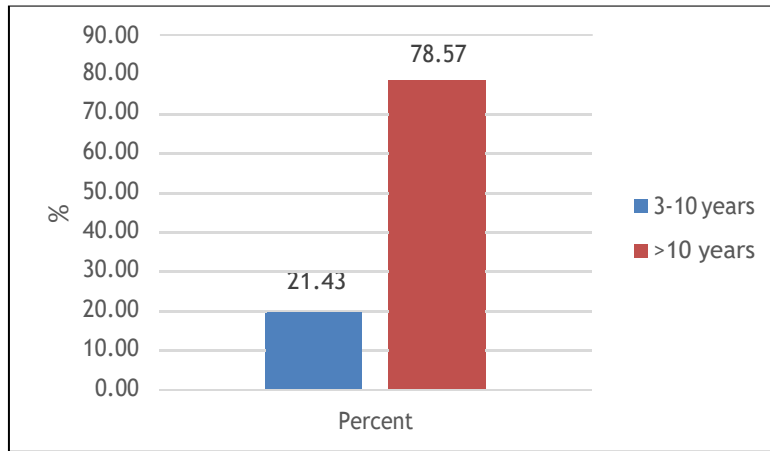


Figure 5. The percentage of the length of time for the supervisors worked as a laboratory technologist

3.1.1.3. Job specialty and length of time working as a laboratory supervisor

The job specialty varies between the participated laboratory supervisors. These include one supervisor specialized in Hematology and Chemistry (7.1%), one in Hematology (14.3%), one in Immunology (7.1%), one in Microbiology (7.1%), three supervisors in Virology (21.4%), one in Cytogenetics (7.1%), one in Cytology (7.1%), two in Histocompatibility (7.1%), one in Genetics (7.1%), and one in Blood bank (7.1%). Moreover, one of the participant's supervisor was overseeing the laboratories overall management process (Figure6). Considering the time working as a supervisor, 9(64.29%) used to work for 3-10 years, four (28.57%) worked for more than a decade, and one (7.14%) worked for less than 3years (Figure7).

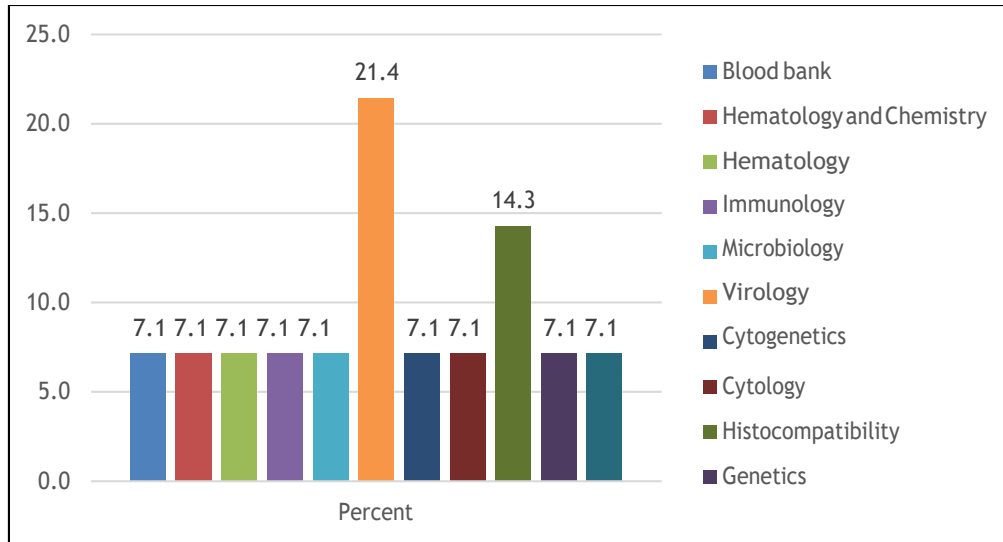


Figure 6. The percentage of the type of laboratory currently being supervised

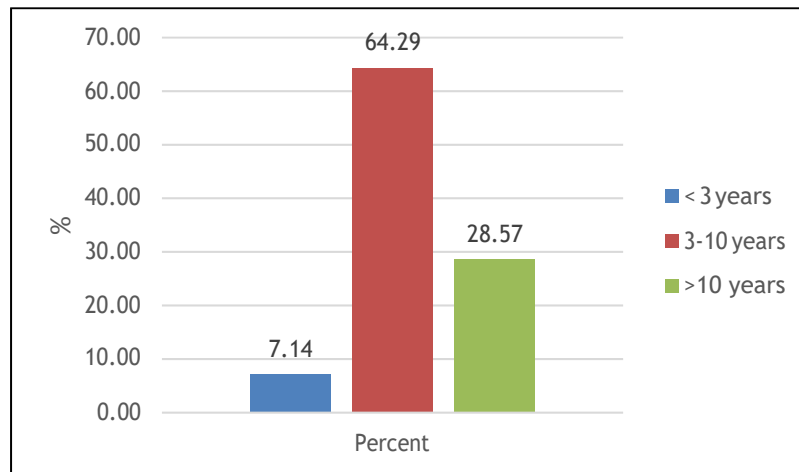


Figure 7. The percentage of the length of time working as a laboratory supervisor

3.1.2. Current practice:

3.1.2.1. Laboratory's role:

The laboratory's role in evaluating the improper test utilization practice is crucial. Of the 14 participants, 13(92.86%) were aware of unnecessary test requests and/or knew

of test utilization areas that can be improved upon, except one supervisor (7.14%) (Figure8). When asked if their laboratory keeps track of incorrect test utilization, 8 supervisors (57.17%) answered yes, while 7 (42.86%) answered no (Figure9). Furthermore, given the ease of detecting incorrect test utilization practices, 11 supervisors (78.6%) responded that it was easy, while 3 supervisors (21.4%) responded as not (Figure10).

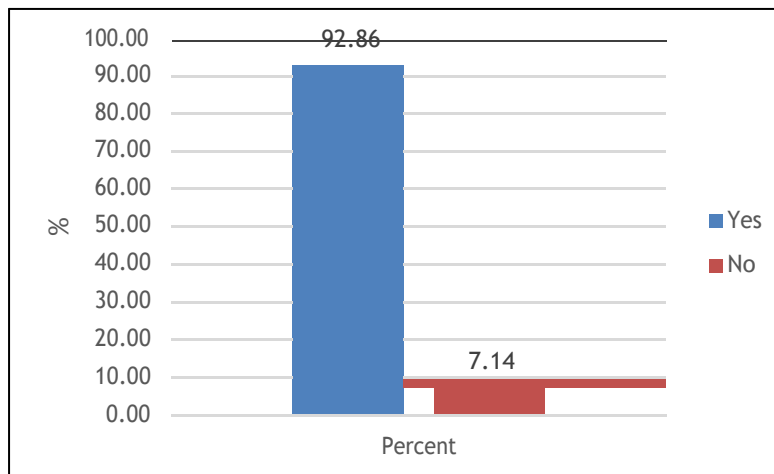


Figure 8. The percentage of the awareness of test utilization areas to be improved

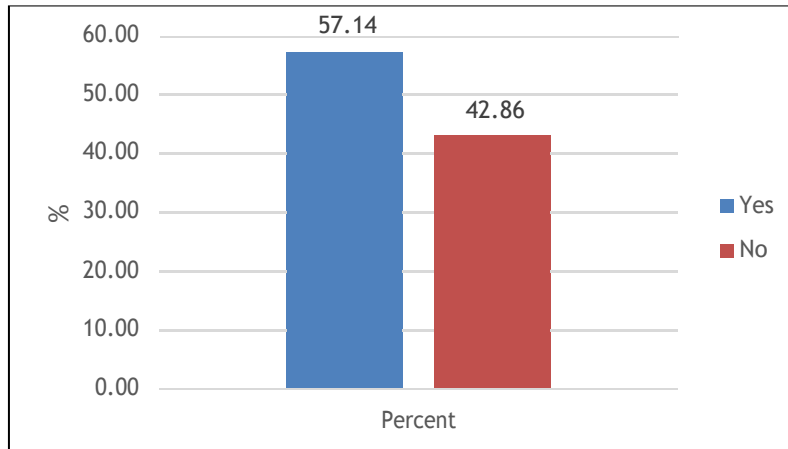


Figure 9. The percentage of the laboratories keeping track of incorrect test utilization

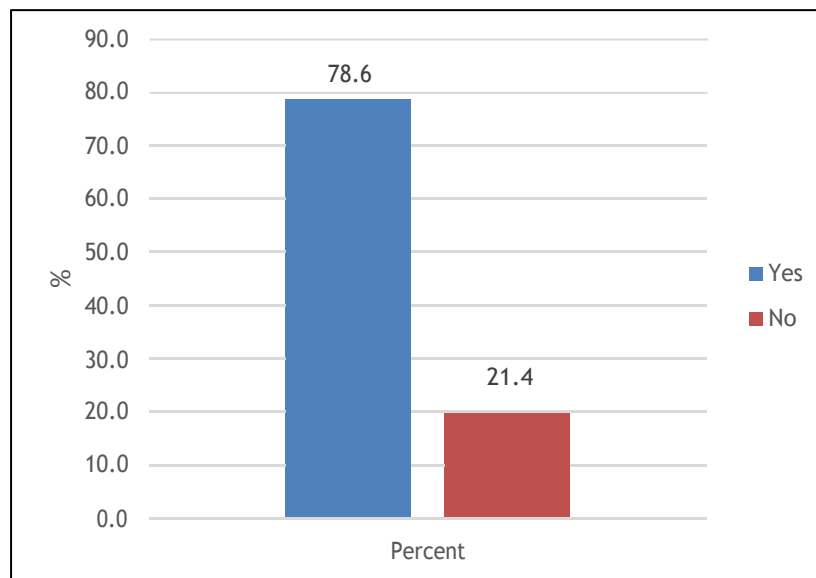


Figure 10. The percentage of the easy identification of incorrect test utilization practice

Concerning the provision of feedback to physicians about their request of incorrect test utilization practices, 5 supervisors (35.7%) were doing so, 5 (35.7%) answered no, and 4 (28.6%) answered sometimes. The last group of answering “sometimes” claimed that

their reasons were for patient management, the physicians are not responding most of the time, and if the physicians were ordering the same test for other patients (Figure11).

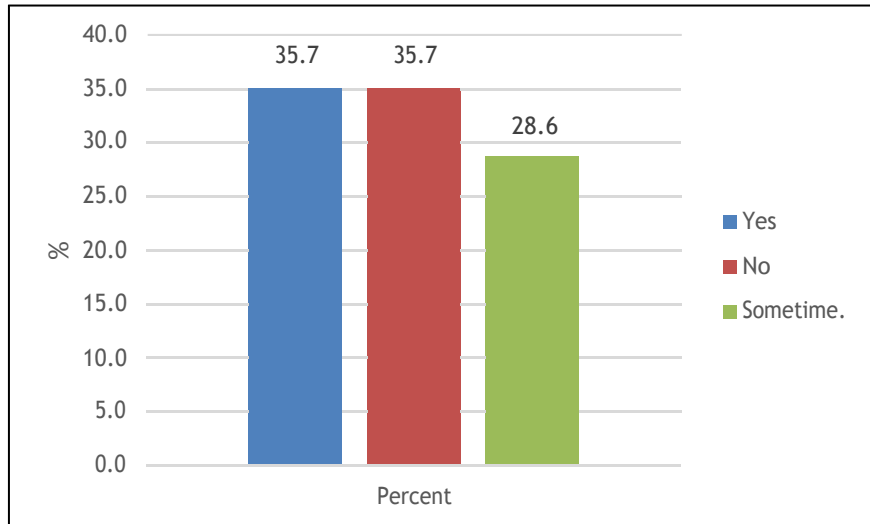


Figure 11. The percentage of the feedback to the physicians about the incorrect practice for test orders

Ten (71.4%) out of 14 laboratory supervisors did not conduct audit regarding test utilization practices; meanwhile, 4 (28.6%) did it (Figure12). However, when asked about the presence of a system to correct improper test utilization practices, 6 (42.9%) indicated the presence of a system to follow, but 8 (57.1%) replied as there is none (Figure13).

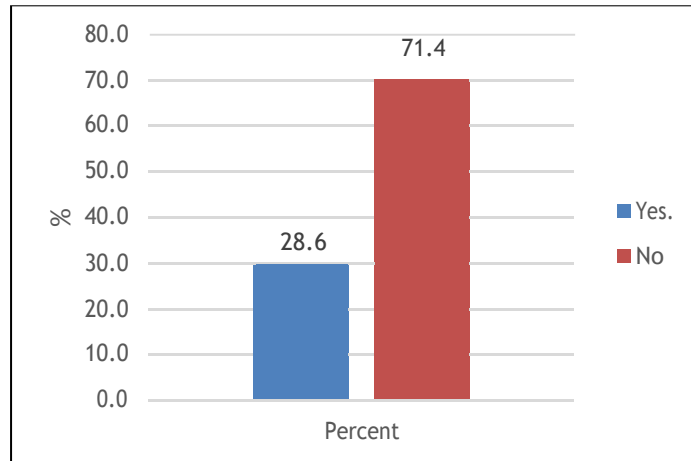


Figure 12. The percentage of Lab conducted audit regarding test utilization practices

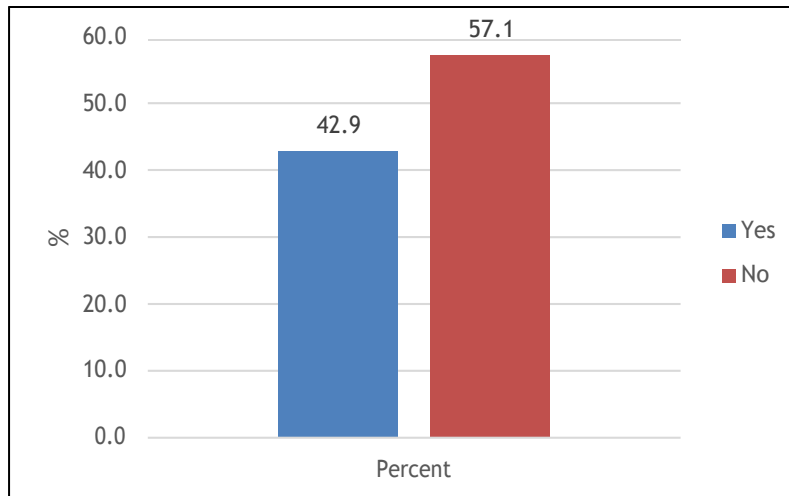


Figure 13. The percentage of the presence of implemented system to correct test utilization improper practices

Among the 14 participants, there were 21 responses. 10(47.6%) were calling the requested physician, 5 (19%) were just doing the ordered test, and 3(14.3%) were releasing old results for the new order with an indication of doing that. Three responses (14.3%) included either report it as the test not indicated (4.8%) add a comment to guide the physician (4.8%) or refer to education and involvement in guidelines (4.8%) (Figure14).

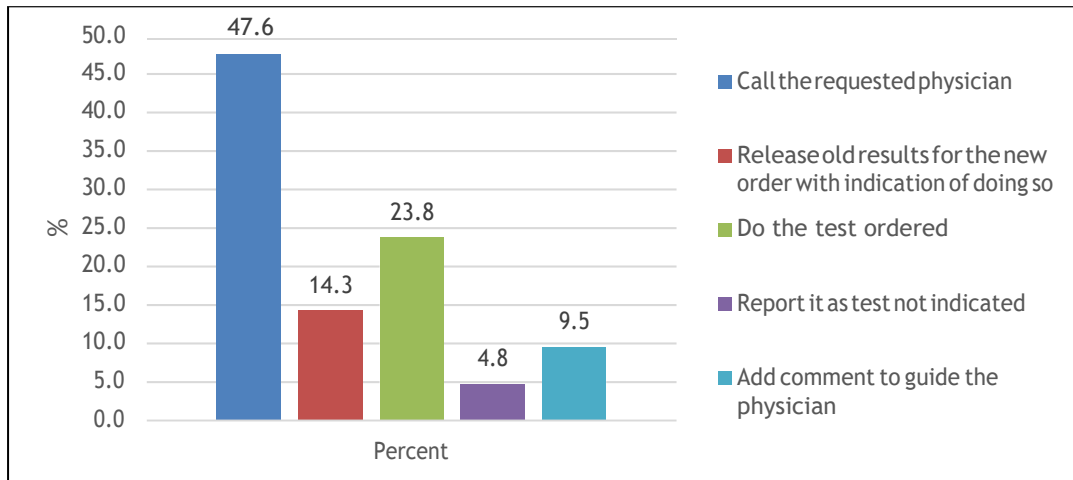


Figure 14. The percentage of the Laboratory's action when faced with an improper test utilization practices

Laboratory handbook is essential to communicate with the physicians. The handbook contains the tests specifications and explains when to order them. In this survey 12 (85.7%) out of 14 indicated that they had an online handbook and they were keeping it up-to-date. On the other hand, the other 2 supervisors (14.3%) didn't have an online handbook (Figure15).

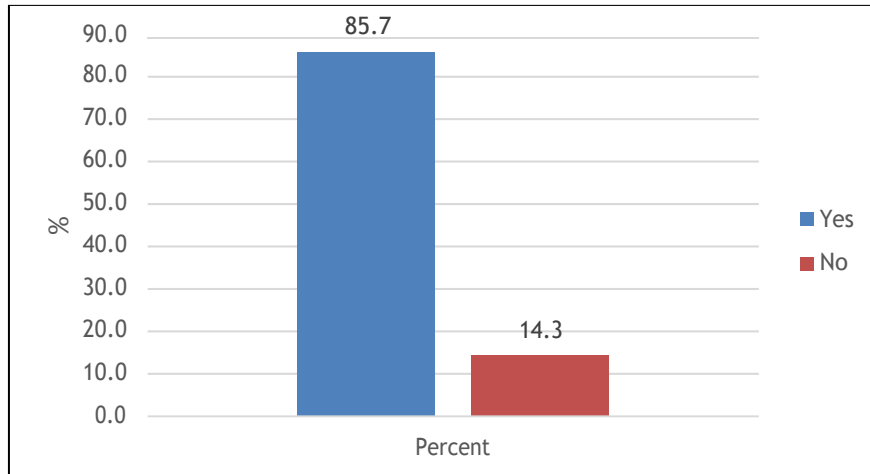


Figure 15. The percentage of the presence and updating the online laboratory handbook

3.1.2.2. Test utilization malpractices:

Out of 14, half of the supervisors (50%) answered yes when asked if their laboratory services are being overused and the half (50%) had answered no (Figure16).

To determine the number of tests that are being overused, the supervisors had been asked about the range of such tests. Out of the 7 supervisors agreed upon overused tests, 4 answered >6 tests, 2 answered 1-3 tests, and 1 answered as 4-6 tests (Figure17).

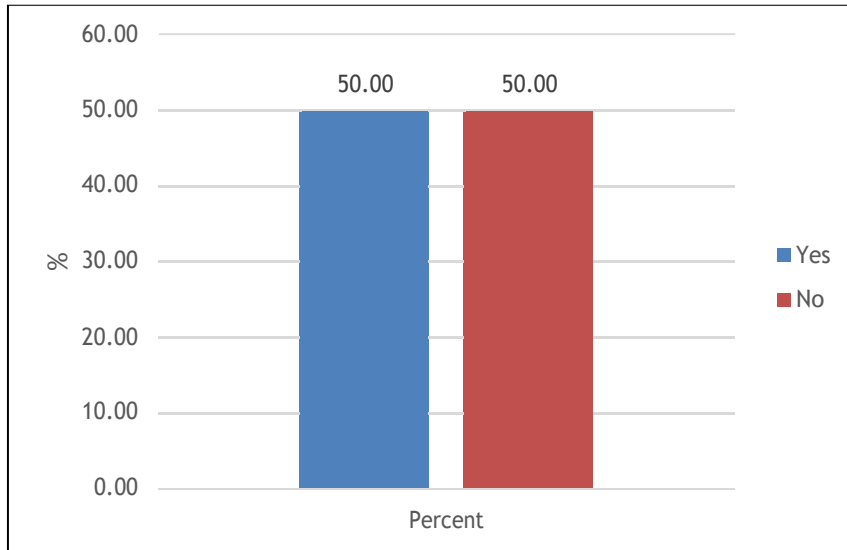


Figure 16. The percentage of the overused laboratory

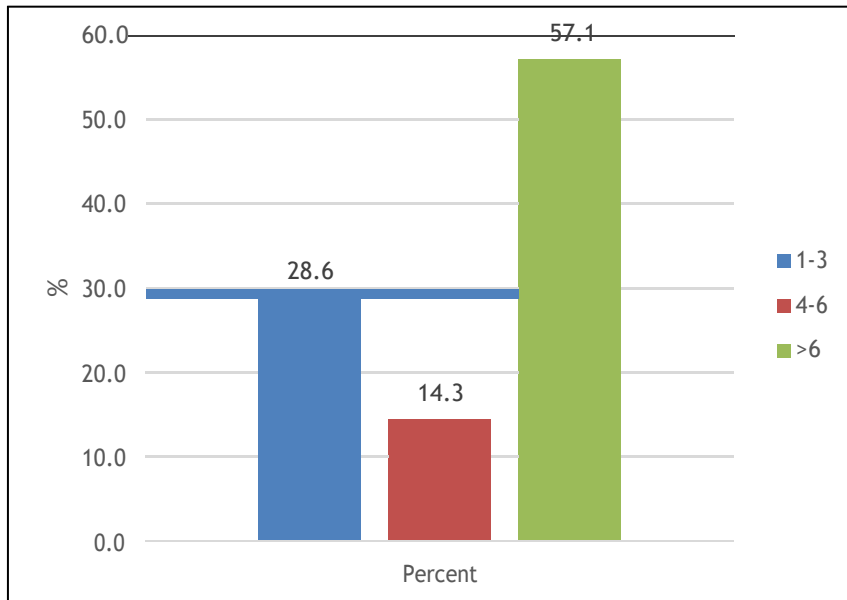


Figure 17. The percentage of the tests being overused within the past 12 months

Two (14.3%) out of 14 supervisors indicated tests are being underused at their laboratories with one of them indicated 1-3 tests and the other indicates 4-6 tests (Figure18,19). The other 12 supervisors (85.7%) indicated no underused tests (Figure18).

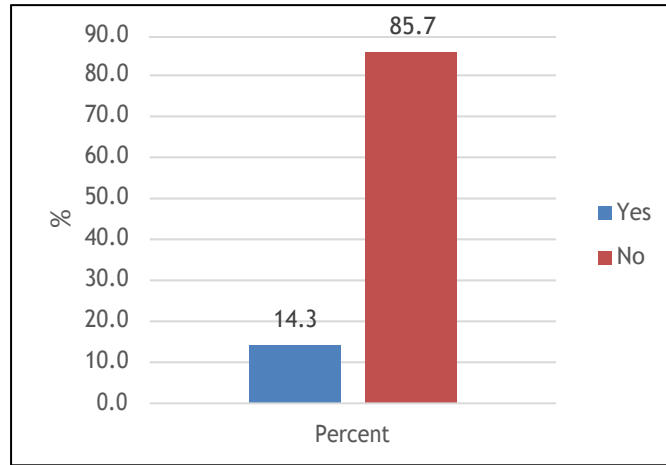


Figure 18. The percentage of the underused laboratory

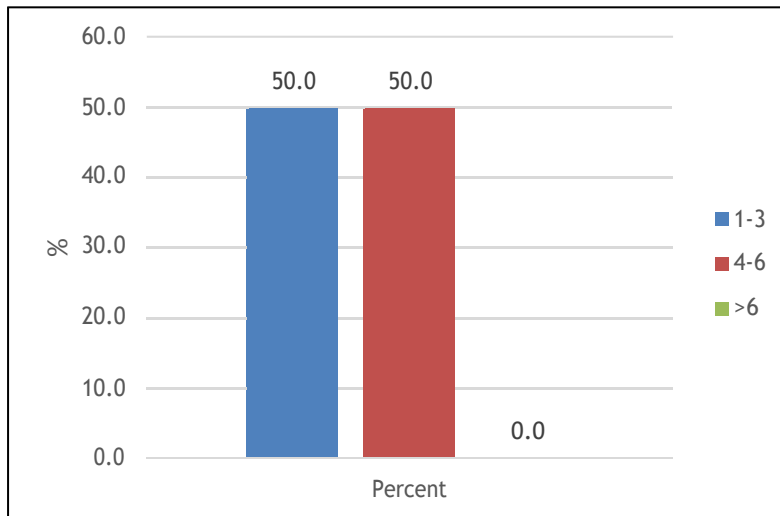


Figure 19. The percentage of the tests being underused within the past 12 months

Regarding the misuse laboratory tests, 5 supervisors (35.7%) suffered from such a problem (Figure20). Three of those supervisors indicated the misused test to be more than 6 tests (60%), 1 (20%) indicated 1-3 tests and another one (20%) indicated 4-6 tests. On the other hand, 9 supervisors (64.3%) had no such practice (Figure21).

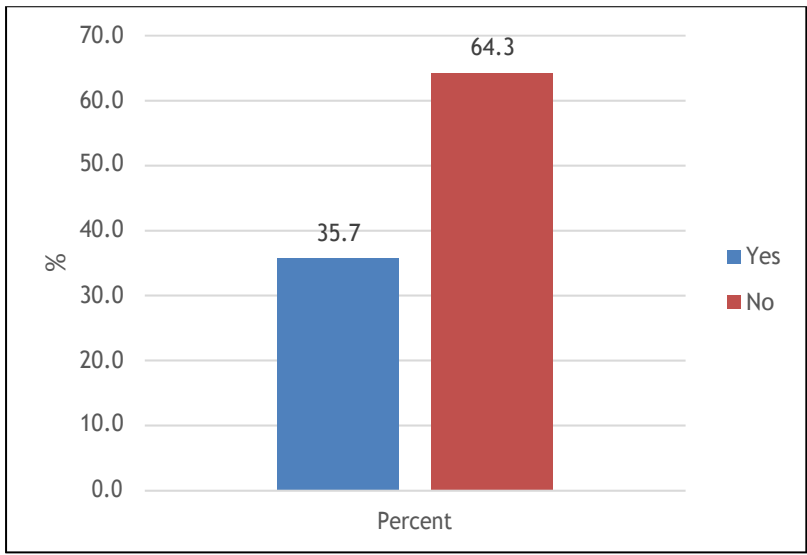


Figure 20. The percentage of the misused laboratory

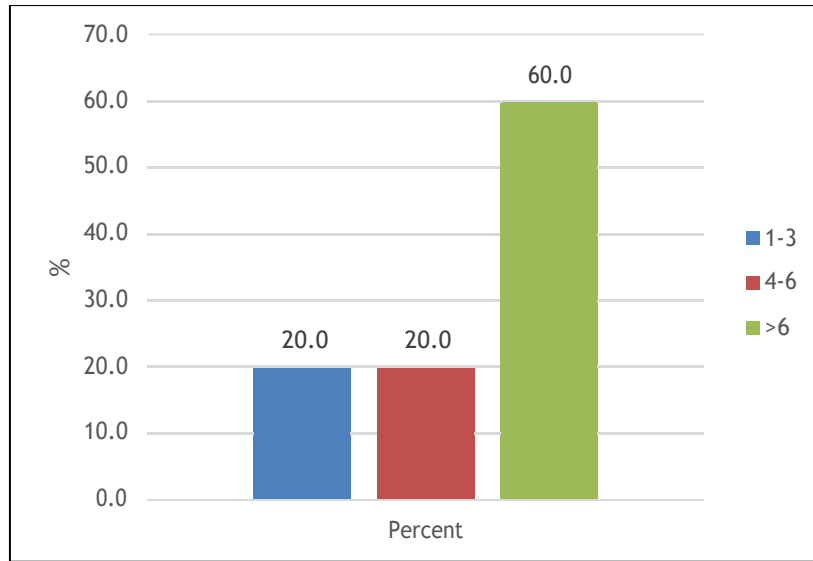


Figure 21. The percentage of the tests being misused within the past 12 months

As demonstrated by Table1, the most common type of improper practice is overutilization of laboratory tests, then misutilization (35.71%) and underutilization (14.29%). To investigate the exact laboratory tests that are being inappropriately used, the supervisors had been asked to list these tests according to the type of improper practice (Table 2).

Table 1. Comparison between types of utilization practice occurrences

Practice/Test per month	1-3	4-6	>6	Total	Percent (%)
Overused	2	1	4	7	50.00
Misused	1	1	3	5	35.71
Underused	1	1	0	2	14.29
Total				14	

The data represent the total number and percentage of inappropriate test utilization practice per a month

Table 2. Test being used improperly

Overused	Misused	Underused
Hepatitis B, C, and Delta	Chromosomal Microarray	Flu
Chromosomal Microarray	Hepatitis B and C, & HCV Genotype	Dengue
Hepatitis B eAg and Hepatitis Delta	Beta thalassemia and Alpha thalassemia Genotype	Molecular test appropriate to clinical condition
Respiratory test	HIV PCR	
Most of the Immunology tests	FISH	
Many – Vit D	Too many to mention	
EBV, VZV and HIV PCR		
Panels of tests		
Troponin		
HbA1C		

The list of laboratory tests that were being used inappropriately

3.1.2.3. Effect of improper test utilization:

For any laboratory, it is important to know how will the incorrect utilization practices affect the lab processes. The predominant effect was increasing the cost with 11 responses (27.7%). The other main effects were bad inventory management, increase the turnaround time, ultimate need for more staff with responses of 9(24.3%), 8(21.6%), and 7(18.9%) respectively. One response (2.7%) indicated no much effect to be mentioned. One response (2.7%) indicated the need to know to improve the lab process (Figure22). Furthermore, when asked if the extent of incorrect test utilization affect the overall costs, 8 supervisors (57.1%) answered significantly, 5(35.7%) answered to some degree, and 1(7.1%) answered as no well-defined effect (Figure 23).

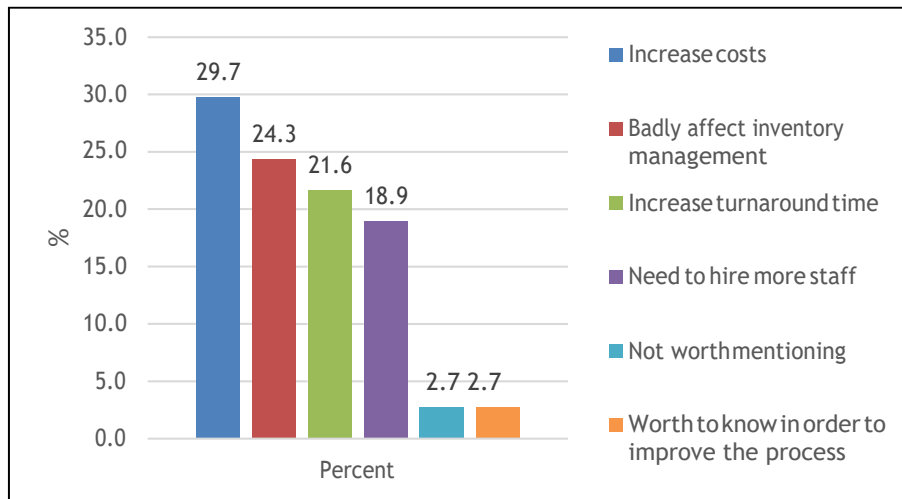


Figure 22. The percentage of the effect of incorrect test utilization practices

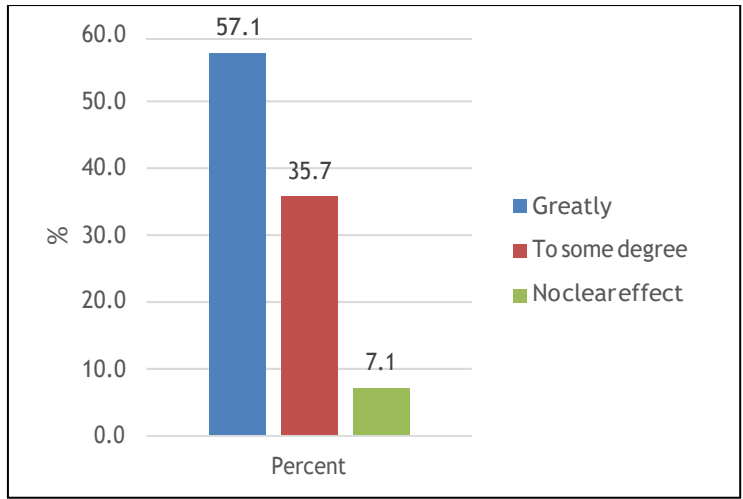


Figure 23. The percentage of the Effect of incorrect test utilization on the overall costs

3.2. Physicians and specialists:

3.2.1. Demographics:

3.2.1.1. Age:

The most common age group is 40-49 years which accounts for 34 (38.6%) out of 88 physicians and specialists. Age groups 30-39 years and more than 50 years were second and third common with a percentage of 30.7% (n=27responses) and 21.6% (n=19 responses) respectively. The less frequent age group in this study was 20-29 year with a percentage of 9.1% (n=8 responses) (Figure24).

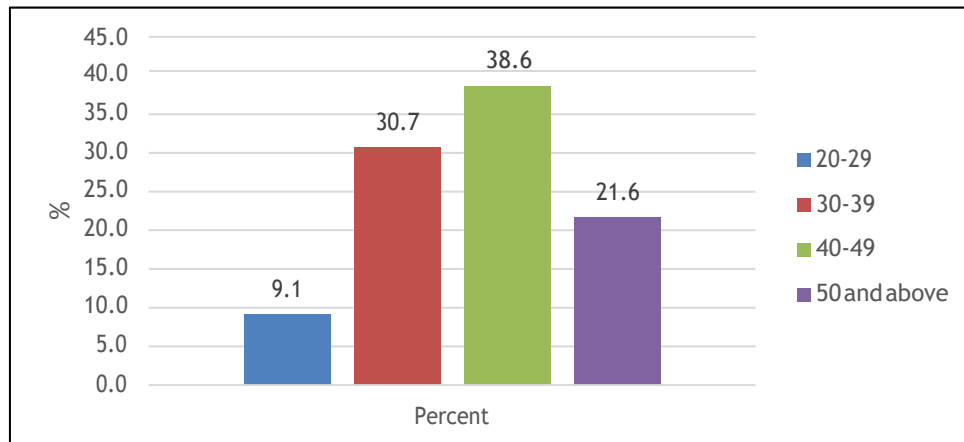


Figure 24. The percentage of the age groups of physicians and specialists

3.2.1.2. Specialty and Length of time working as a general physician or specialist:

Sixty-five participating clinicians (73.9%) out of 88 got their Medical degree outside Qatar, whereas 23(26.1%) got their degree in Qatar (Figure25). Out of the participants (n=88), the specialists account for 78(88.6%); meanwhile, the general

physicians account only for 10 participants (11.4%) (Figure26). The length of time spent by many participants worked as general practitioners more than 10 years was (40.9%), followed by 3-10 years and less than 3 years with a percentage of 27.3% and 19.3%, respectively. Because working as a specialist from the beginning, eleven participants (12.5%) answered as not applicable (Figure27). On the other hand, the length of time participants worked as a specialist accounted for 43 (48.9%) for more than 10 years, 32(36.4%) for 3-10 years, and 4(4.5%) less than 3 years. The last 9 participants (10.2%) are still working as general physicians (Figure28).

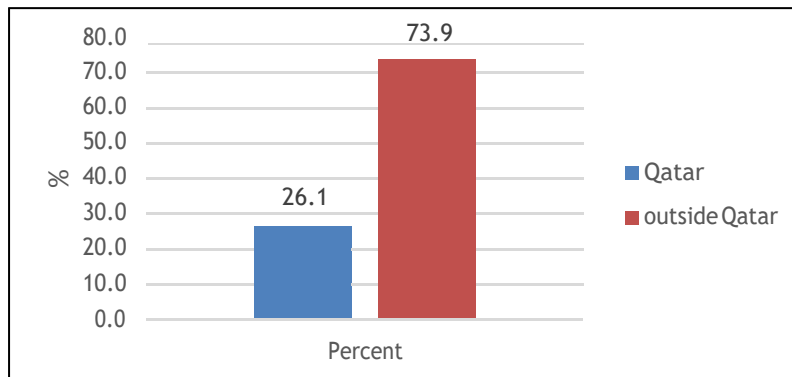


Figure 25. The percentage of the country where highest degree obtained for physicians or specialists

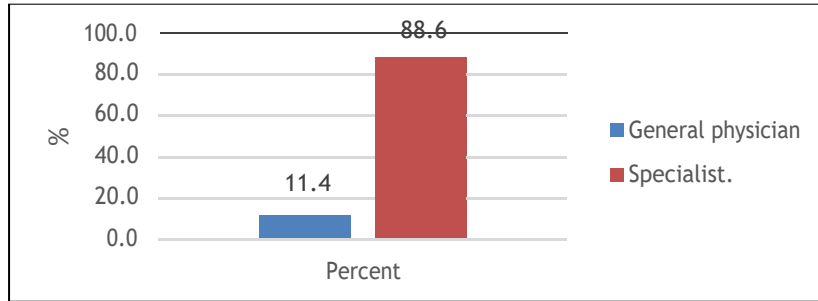


Figure 26. The percentage of the specialty of physicians

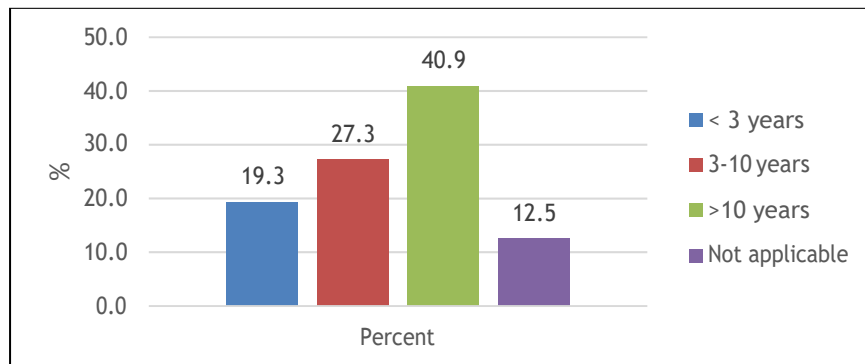


Figure 27. The percentage of the length of time working as a general physician

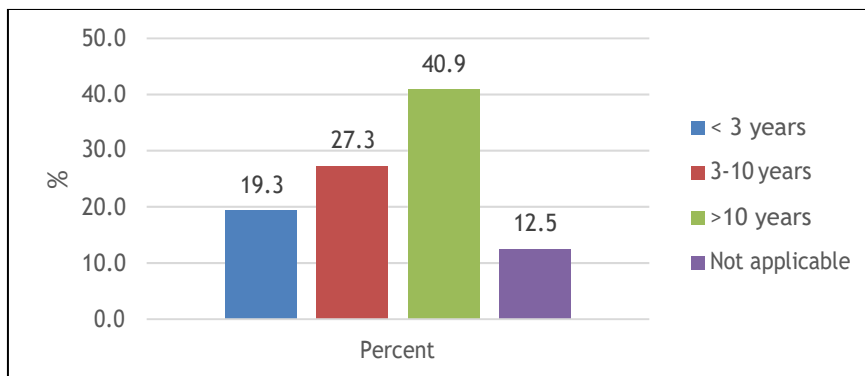


Figure 28. The percentage of the length of time working as a specialist

3.2.2. Current practice:

3.2.2.1. Current software and its properties:

To identify the causes behind improper test utilization practices, the physicians had been asked about different aspects of the current ordering system. Since current software (Cerner) being used is the main ordering tool, and the main concern is the redundant test ordering, 52(59.1%) of the physicians indicated that they were not alerted about the redundant test when being ordered. The others, 23 (40.9%) reported being alerted regarding such practice (Figure29). Another important part of the Cerner is the electronic ordering templates. 80(90.9%) of physicians agreed on the help they get using the electronic template, while 8(9.1%) didn't (Figure30). Moreover, the way the patient result is being displayed by Cerner affected 63(71.6%) of the physicians; yet 25(28.4%) were not affected (Figure31). Furthermore, when asked about the aid of corollary order notifications (i.e., consequent electronic orders for laboratory tests that are required because of other orders), 62(70.5%) physicians agreed, while 26(29.5%) disagreed (Figure32). Also, physicians had been asked if the reflex testing protocols (i.e., electronic protocols allow for additional tests to be ordered depending upon the results of the first test or tests) help in ordering the right tests; 78(88.6%) answered yes, but 10(11.4%) answered no (Figure33).

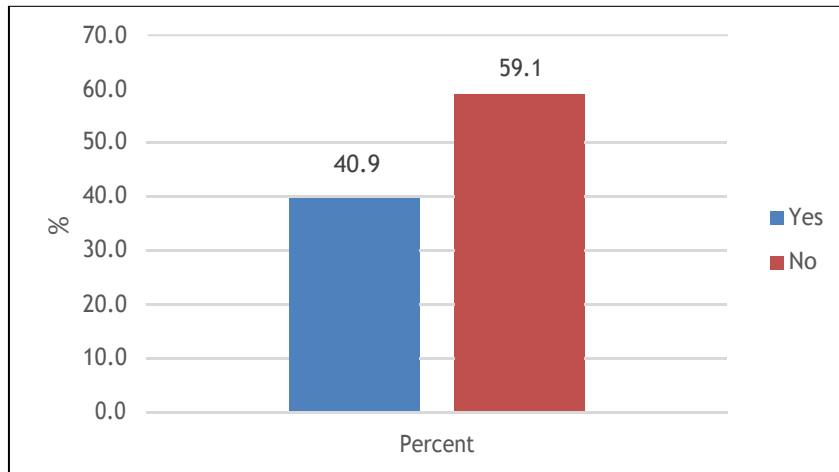


Figure 29. The percentage of physicians is getting alerts by the current software on the redundant test once they order it

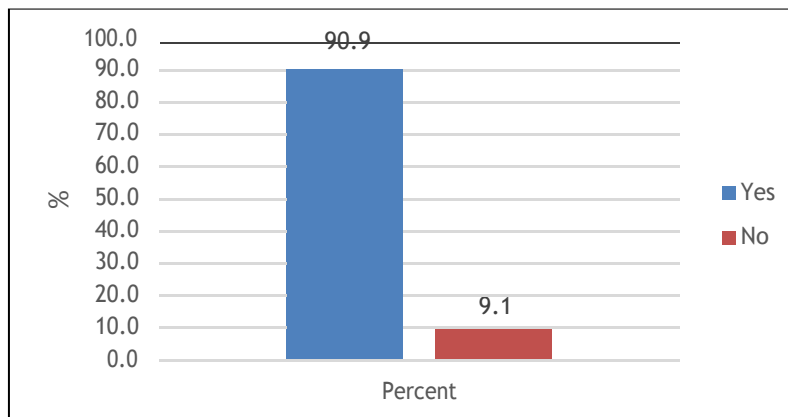


Figure 30. The percentage of physicians finding the electronic ordering templates helpful in choosing appropriate tests

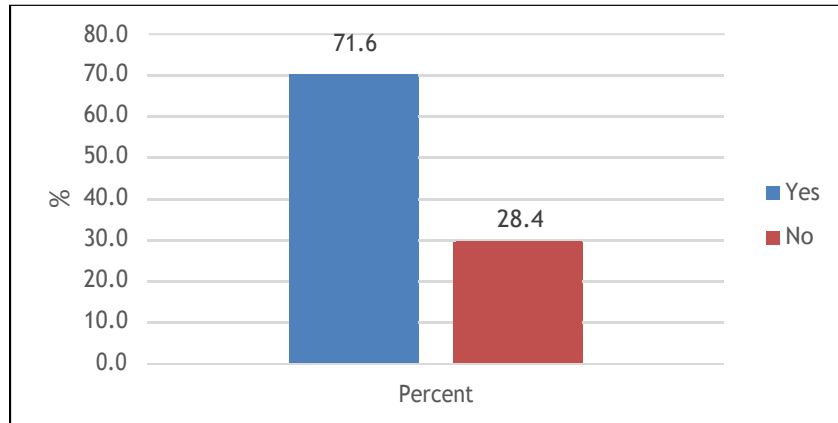


Figure 31. The percentage of physicians finds Cerner properly display the test results

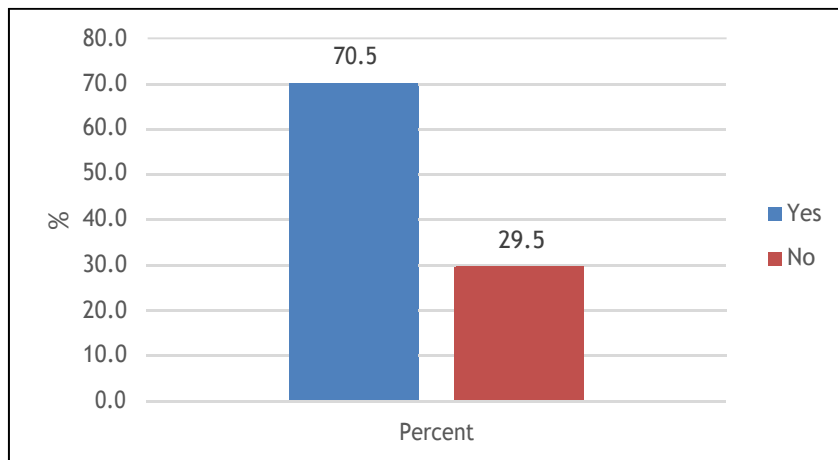


Figure 32. The percentage of physicians finding corollary order notifications useful in choosing appropriate tests

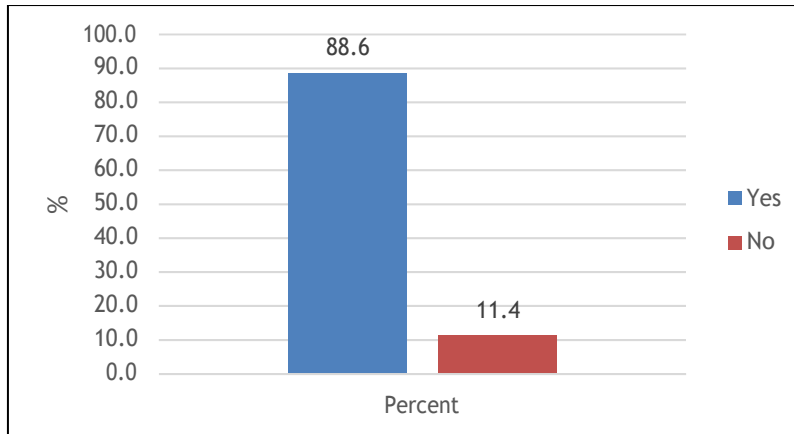


Figure 33. The percentage of physicians finding reflex testing protocols useful in choosing right tests

3.2.2.2. Available information sources:

The second part that influences test utilization practices is the available information. Sixty-nine (78.4%) of physicians were using the available clinical practice guidelines. Six physicians stated that such guidelines are not helpful (6.8%) to choose the appropriate tests or thirteen are not sure (14.8%), which indicates they were not using the guidelines (Figure34). In addition, 44(50%) of physicians reported the presence of enough resources to help in choosing the appropriate tests, while 29(33%) were not sure and 15(17%) indicated the absence of these resources (Figure35). To improve the result interpretations and influence future test selection, the physicians had been asked if pathologist interpretation accompanies test results are useful. 54(61.4%) affirm the usefulness of such interpretations. Meanwhile, 31(35.2%) stated sometimes they are useful, and 3(3.4%) said they are not (Figure36). Another important source of information is the Laboratory Handbook. Astoundingly, 65(73.9%) of the participated physicians indicated

that they were not using the handbook. However, 15(17%) reported the practicality of the information included in the handbook, while 8(9.1%) reported them useless (Figure37). Moreover, the Positive Predictive Value (PPV), the Negative Predictive Value (NPV), Clinical Utility (CU) and the overall accuracy of the test are of great importance before ordering any test. Twenty-nine physicians (33%) are considering these parameters, 46(52.2%) stated when needed, and 13(14.8%) weren't considering these parameters (Figure38). When the diagnosis is obscure, 26(39.5%) of the physicians prefer to order tests in parallel, 41(46.6%) prefer to order in sequence, and 21(23.9%) stated that their ordering pattern would depend on the suspected diagnosis (Figure39).

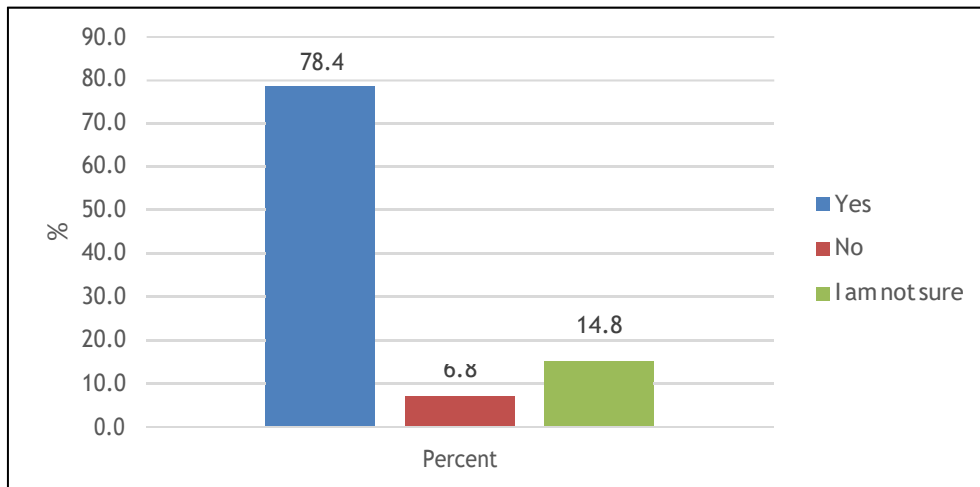


Figure 34. The percentage of the physicians find available clinical practice guidelines useful in choosing appropriate tests

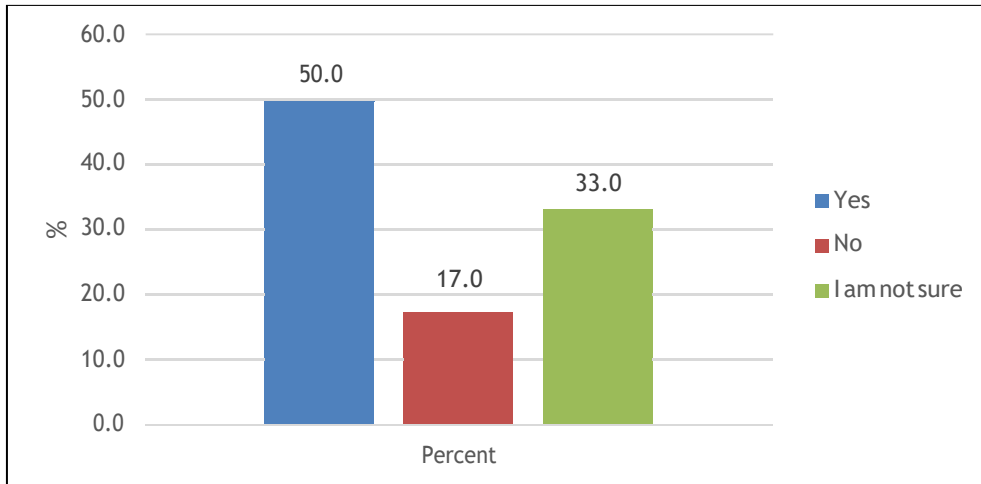


Figure 35. The percentage of physicians point out there are enough resources available to guide them in choosing appropriate tests

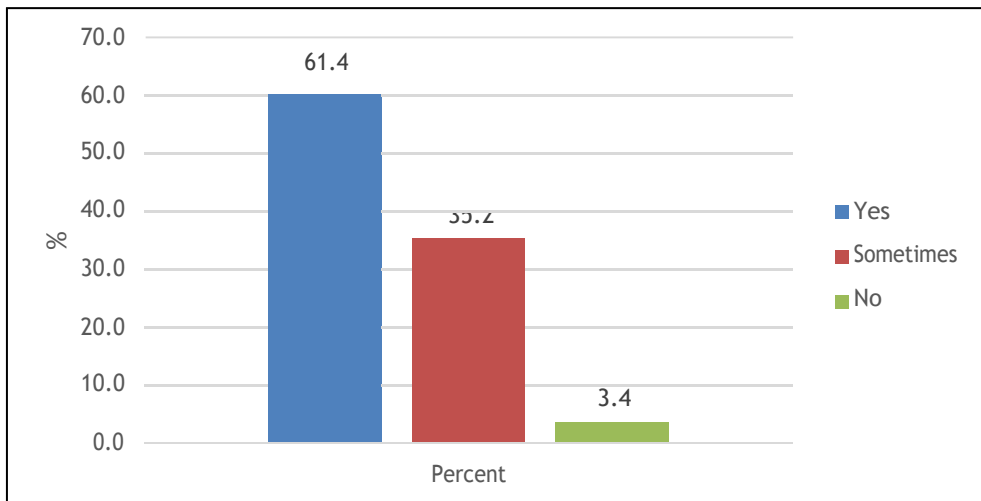


Figure 36. The percentage of physicians who find pathologist interpretations accompany test results usefully

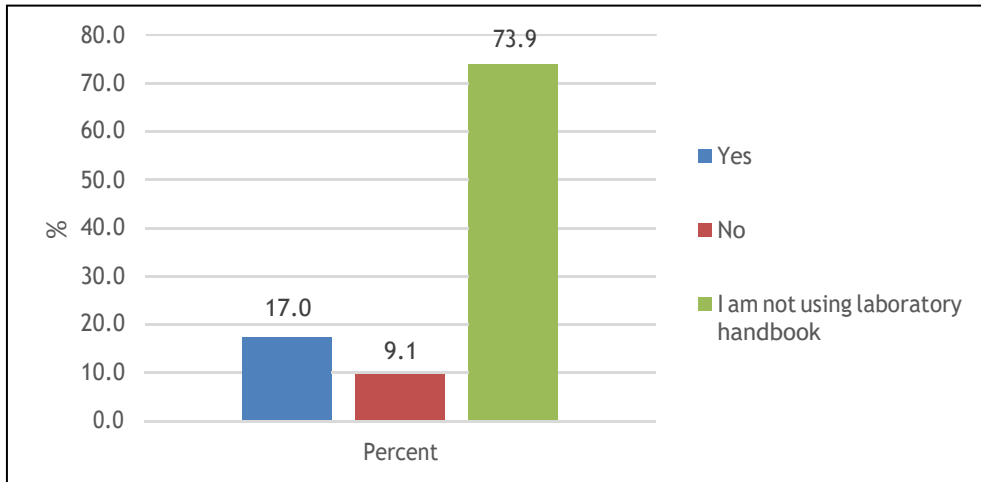


Figure 37. The percentage of physicians think that the information in laboratory handbook is helpful in choosing the right test

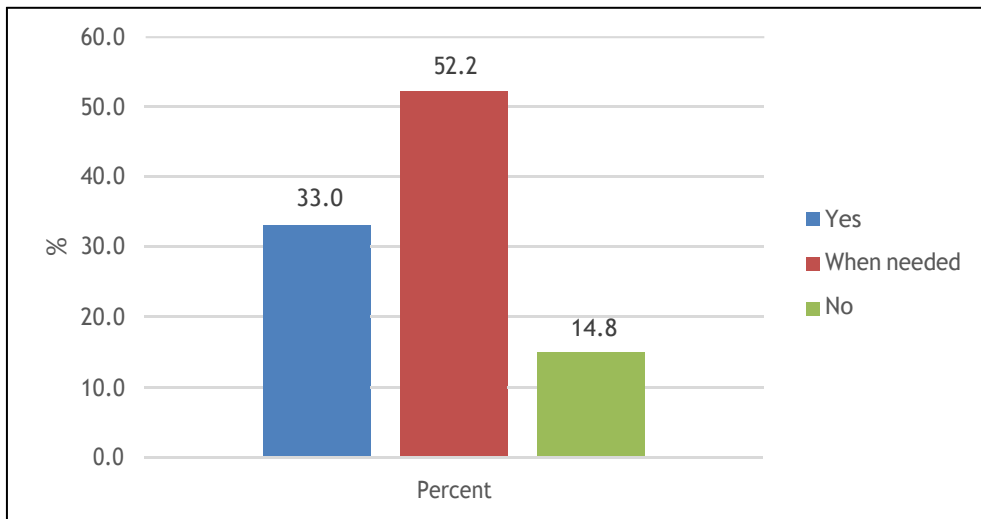


Figure 38. The percentage of physicians consider the test parameters before ordering

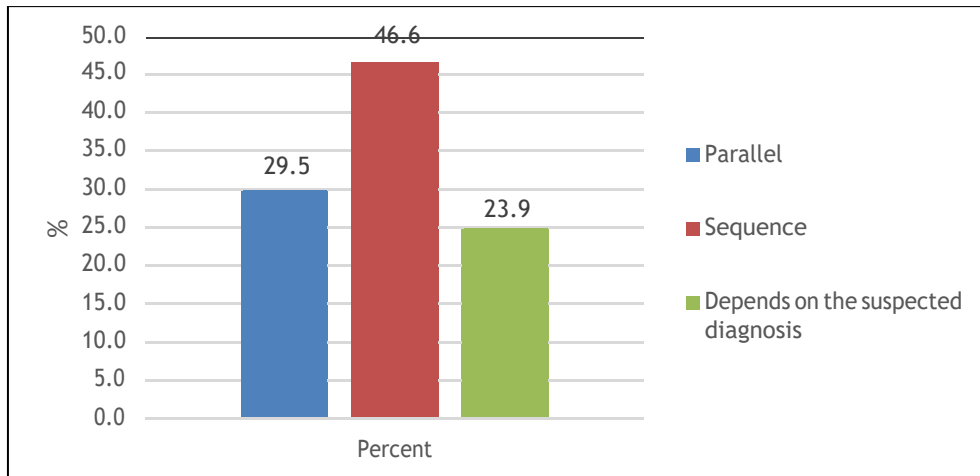


Figure 39. The percentage of test ordering patterns when diagnosis is obscure

3.2.2.3. Others inquiries/assessments/involvement:

People surrounding the physicians can affect their decisions or even takes the lead in certain situations. The frequency of asking colleagues about the precise test to be ordered is anything but zero. 51(58%) physicians sometimes ask their colleagues about the right test, 10(11.4%) often, and 27(30.7%) rarely asking their equals (Figure40). In addition, 84(95.5%) of the participants are welcoming the idea of receiving feedback regarding improper test ordering behavior from the laboratory. The other 4(4.5%) didn't prefer getting feedbacks because either as they stated that they hardly order the additional unnecessary test, they have no time, or they are not sure (Figure41). Surprisingly, most physicians (51.1%) indicated that they had not been contacted regarding improper test utilization practice and (40.9%) of the participants responded as rarely. Only seven physicians reported getting frequent feedback regarding their practices (Figure42). Hence, the total number of physicians that had been contacted rarely or frequently is 43. Moreover,

when asked about the individuals who contacted the physicians regarding the improper test utilization practice, 54(58.7%) answered not applicable. Meanwhile, 25(27.2%), 6(6.5%), and 3(3.3%) responses showed that the participants were being contacted by Laboratory staff, Laboratory consultant, and Laboratory manager, respectively. Four of the responses specified the involvement of colleagues, electronic health record (EHR), nurses and Cerner (Figure43). On the other hand, the number of the physician’s favoring laboratory’s feedback reduced to 64(72.7%) when asked if they prefer the chair of the division to share the de-identified ordering patterns with them to improve their ordering behavior, and 24 (27.3%) said no (Figure44). Furthermore, to reduce improper test ordering, the physicians had been asked if they prefer a specialist in the field to be the only person allowed to order esoteric tests; 56(63.6%) of them agreed to the proposition, but 32(36.4%) disagree (Figure45).

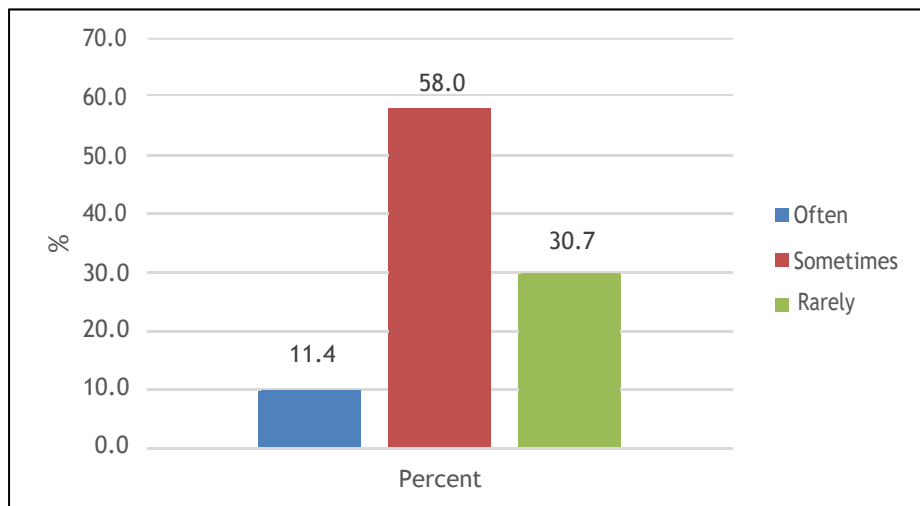


Figure 40. Frequency of asking colleagues about the right test to be ordered

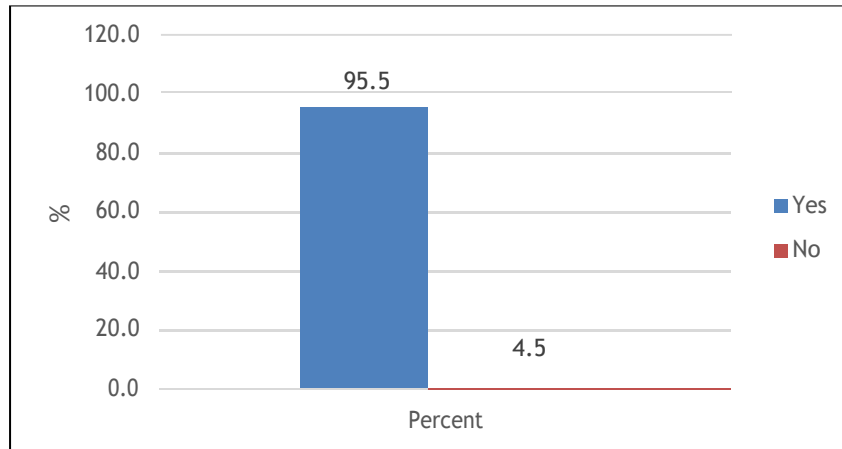


Figure 41. The percentage of reference to receiving feedback from the laboratory

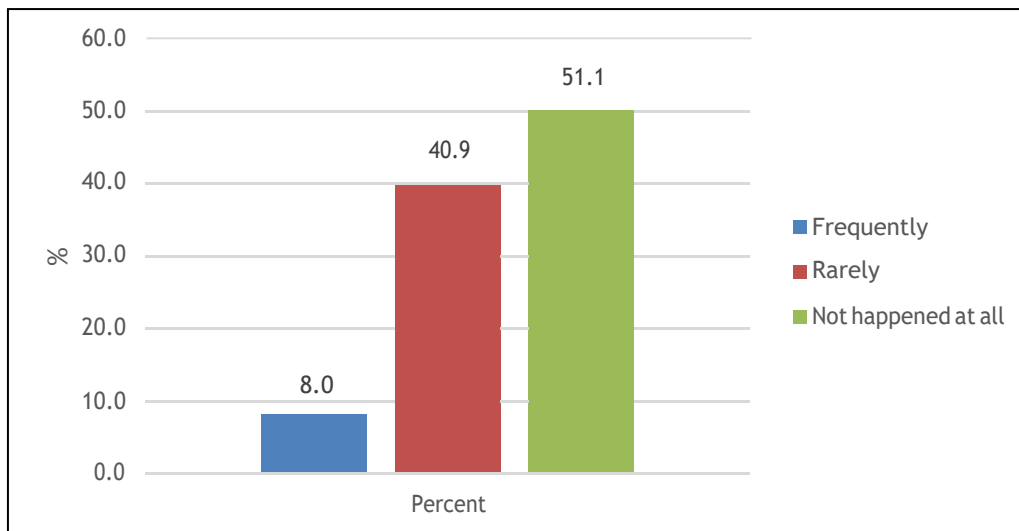


Figure 42. Frequency of being contacted regarding improper test utilization practice

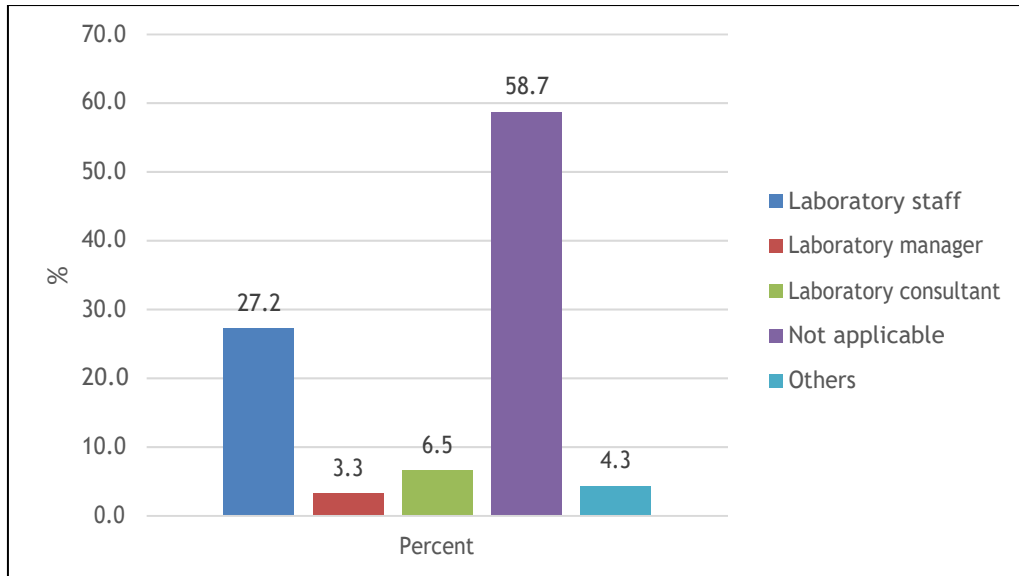


Figure 43. The percentage of individuals contacting physicians regarding the improper test utilization practice

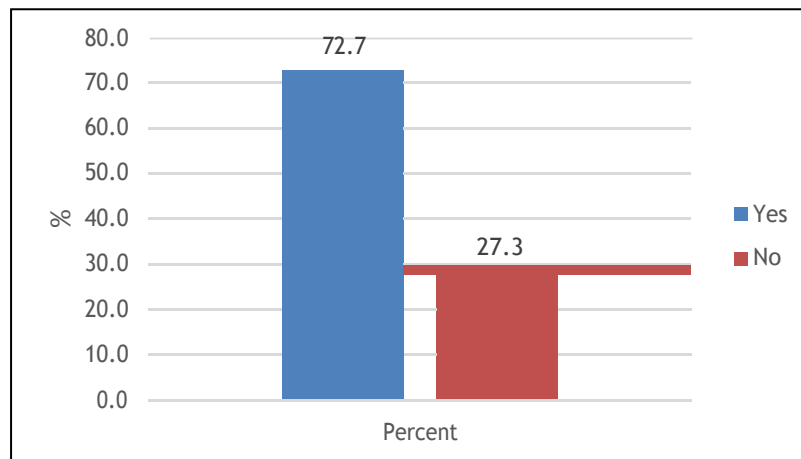


Figure 44. The percentage of physicians prefer the chair of the division to share the de-identified ordering patterns with them

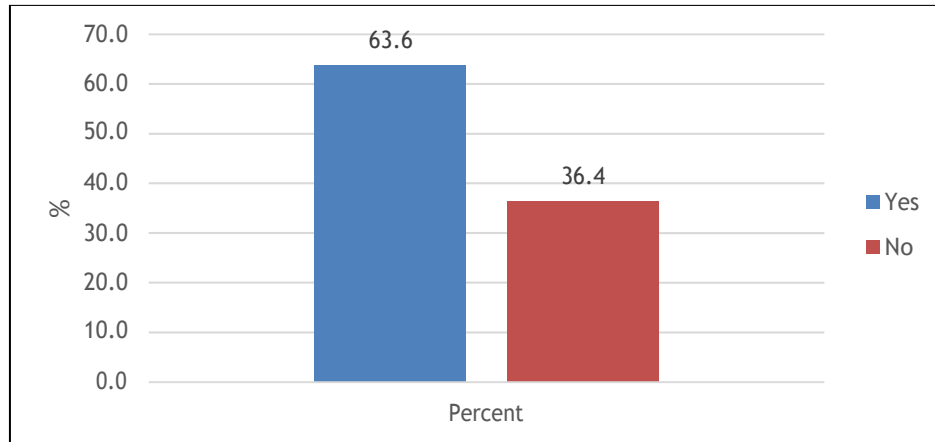


Figure 45. The percentage of physicians prefer the esoteric tests to be ordered only by specialists

3.2.2.4. Test outcome/results:

All the participants reported that they consider the test outcomes (normal, abnormal, and equivocal) with the treatment plans is prior to ordering(Figure46). Moreover, 86(97.7%) of the physicians consider the time required to obtain test results and account for the degree to which an abnormal test value (even if obtained expeditiously) could affect their diagnosis before ordering a test. However, 2(2.3%) were not (Figure47).

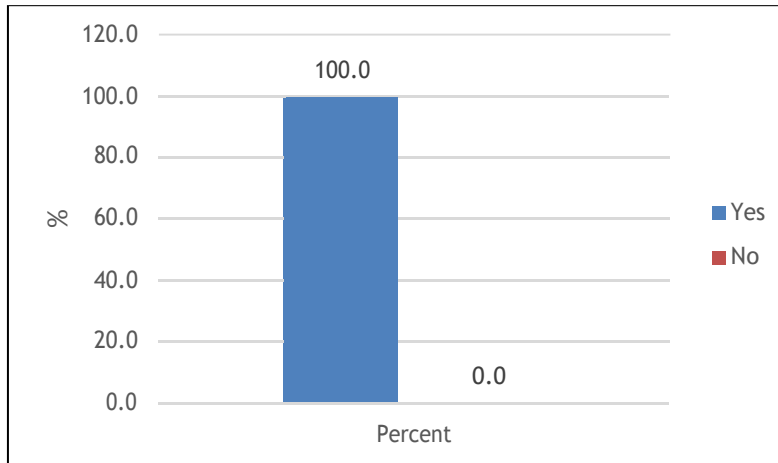


Figure 46. The percentage of physicians considering the test outcomes before ordering a test

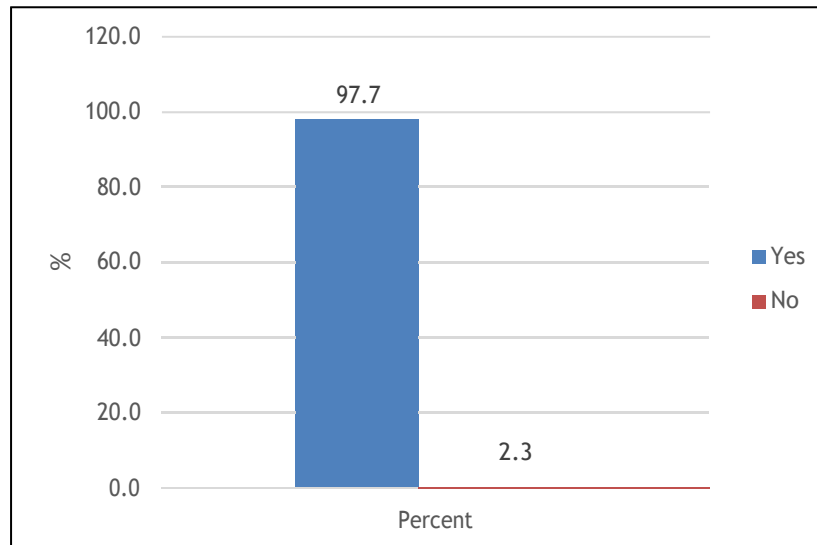


Figure 47. The percentage of physicians consider the time to obtain the test result and the degree to which an abnormal lab value may affect their diagnosis

3.2.2.5. Test cost:

Fifty-nine of the physicians (67%) were not aware of the financial cost per each test, while 29(33%) were aware (Figure48). When asked about the influence of high-cost tests, 56(63.3%) reported that they would reduce their ordering, but 32(36.4%) said it does not affect (Figure49). In the other hand, when the participants were asked about the low-cost tests, 62(70.5%) replied it does not affect, while 17(19.3%) reported an increase and 9(10.2%) reported reduce ordering of such tests (Figure50).

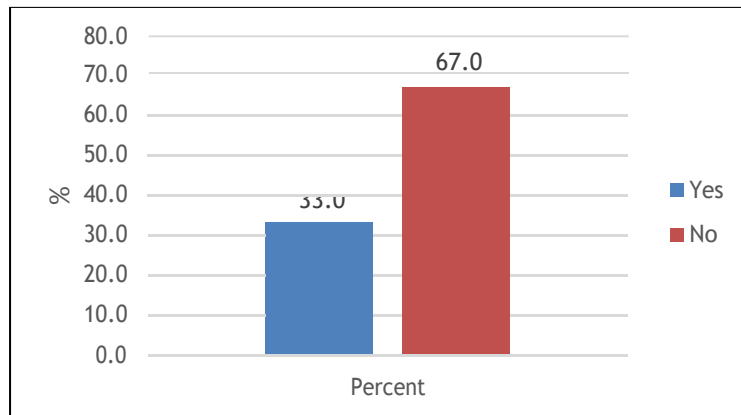


Figure 48. The percentage of physicians aware of the cost of testing

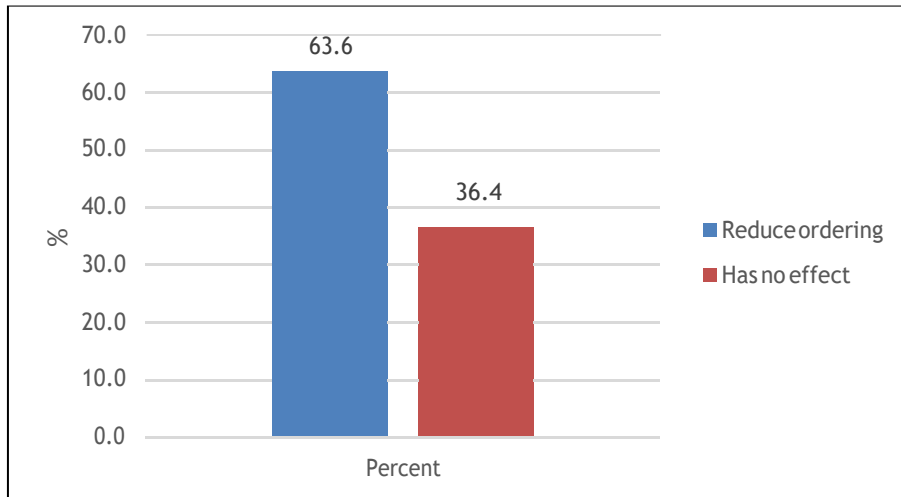


Figure 49. The percentage of different physicians' actions towards high-cost tests

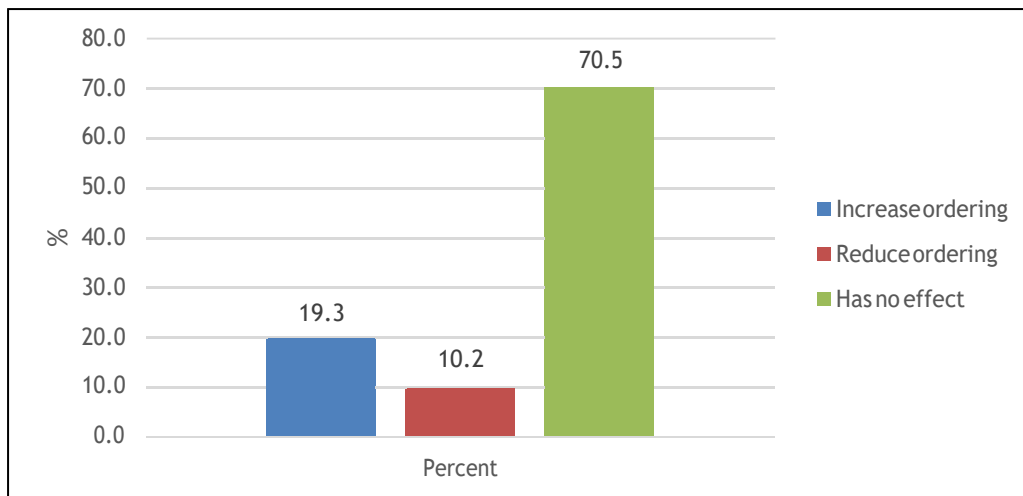


Figure 50. The percentage of different physicians' actions towards low-cost tests

3.2.2.6. Other factors:

Other factors that influence physician's or specialist's ordering behavior varies. Out of 211 responses, many highlighted the ease of ordering (44responses, 20.9%), desire for certainty of diagnosis (n=43 responses, 20.4%), impatience (n=40responses, 19%), and patient demand (n=35 responses, 16.6%). The others indicated the effect of peer- or supervisor pressure to be extremely thorough (n=22 responses, 10.4%), fear of litigation (n=15 responses, 7.1%), financial incentives (n=9 responses, .34%), ignorance of test characteristics (2 responses, 0.9%), and part of management and follow-up plan (n=1 response, 0.5%).

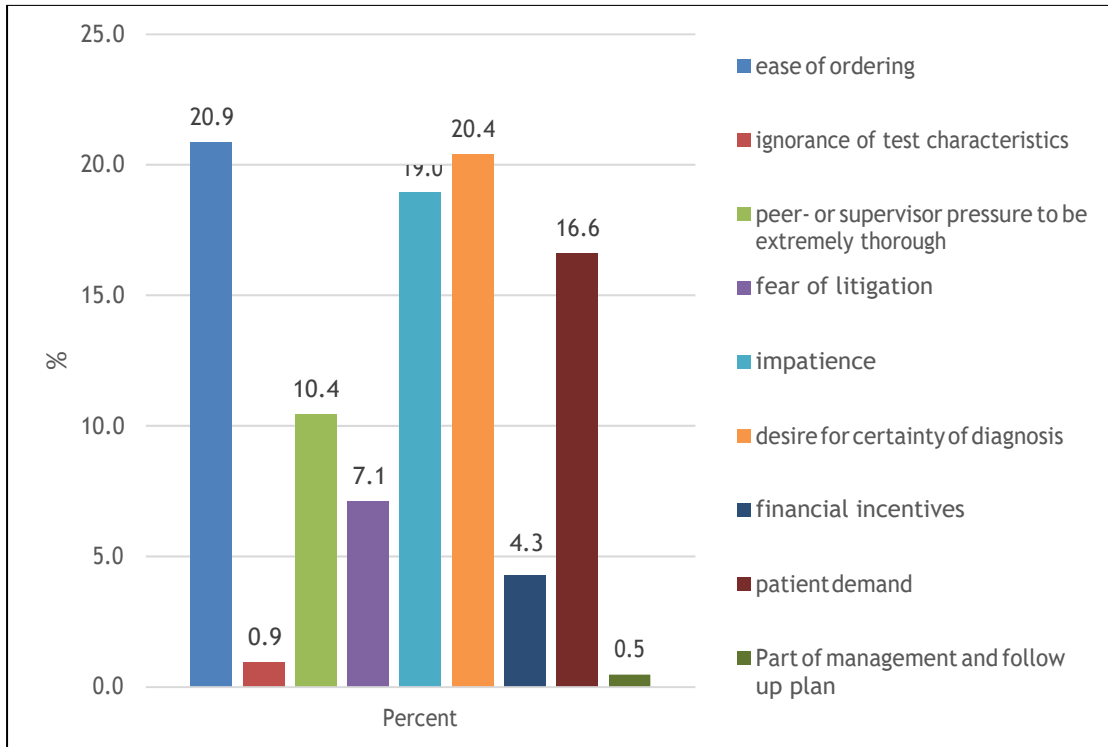


Figure 51. Other factors that influence physician's ordering behavior

5. CONCLUSION

A developed country like the US is trying hard to solve the issues with test utilization improper practices and publish many articles in this regard because of the amount of money being wasted instead of using it wisely in other industries. Because of Qatar's Vision 2030, Hamad Medical Corporation should take good initiatives and specific measures to improve health care while reducing the costs. Many factors result in the inappropriate test utilization practice controlled by the two most important health care players; laboratories and physicians. Laboratory supervisors require appropriate training from HMC to establish a robust system to overcome improper test utilization practices. This system should include regular feedbacks and audits and develop user-friendly handbooks. On the other hand, physicians practice can be improved through customizing CPOE software to give suitable alerts and notifications, limiting search terms, better laboratory communications with frequent feedbacks, reading laboratories handbooks, better continuous education courses, peer- senior- physicians constructive feedback, increase awareness of the cost of testing, and understand and overcome other factors that may result in improper test utilization. This study gave some suggestions about protocols or systems that may help laboratories and physicians to eliminate unnecessary testing safely and efficiently with the necessary administrative support. In-depth test utilization investigations must be conducted in each laboratory to find more specific solutions and improvement strategies.

4. DISCUSSION

The current study is the first survey conducted in Qatar about Test Utilization Management. Two surveys were conducted, one for laboratory supervisors and the other one is for physicians (general practitioners or specialists), to highlight the areas that need improvements and reduce health care costs.

Good laboratory management practices are important factors that will greatly impact laboratory processes. Fourteen different laboratory supervisors had been surveyed. Most of the supervisors did not have a degree in laboratory management and worked as technologists for more than 10 years. Also, they have worked as supervisors for a period of 3 and 20 years. However, this should not be enough to start managing a laboratory without proper specialized laboratory management training. One supervisor said in an interview that there is no provision of any program or any educational hours related to laboratory management by HMC and the supervisors were educating themselves. Also, the supervisor depicted that there was a Diploma of General Management provided by HMC once, and only two laboratory supervisors participated. Fortunately, many supervisors (92.86%) were aware of the test utilization areas that can be improved upon, and many (78.6%) could detect incorrect test utilization easily. Nonetheless, as a reply to improper practices, only 57.14% were keeping track, 35.7% were calling the requested physicians, and 28.6% conducted an audit of such incorrect utilization practices. Moreover, less than half of the lab supervisors (42.9%) were using a systematic approach to correct test utilization improper practices. Thankfully, many supervisors (85.7%) recognized the importance of the laboratory handbook and updated theirs regularly.

As widely known, this study showed the main concern of test utilization was over-used laboratory tests (50%) as shown in previous studies (14,19). For example, our study showed that HbA1c was being overused. Two studies by Trivelli et al. and Lyon et al. disclosed that HbA1c overutilization was evidenced by unnecessarily repeated measurements within 10 days and 30 days, respectively (20,21). One more example of overutilization presented by this study is vitamin D which is also shown by Rollins et al. to utilize 100% or more of vitamin D testing in many laboratories (22). Then, comes the test that is being misused with a percentage of 35.7%. One of the tests that are being misused is the thalassemia genotyping. Dickerson et al. stated that genetic testing was of the most expensive and misused tests (23). Finally, the underused tests scored a percentage of 14.3% in our study. One participant indicated that underused tests are those molecular tests which were fitting the clinical condition of the patient. One study by Levy et al. showed that BRCA1/2 tests for high-risk breast cancer patients are being underutilized in the USA (24). Further investigations are required for different types of tests that were being inappropriately used and because one participant stated there are many to be counted. (Table 2).

Like the USA, our data shows the core apprehension of test utilization is increasing the cost of the laboratory due to overused tests (8). Most of the supervisors stated that the effect on the cost is substantial as it will require hiring more staff, bad inventory management, and patient diagnosis/treatment/follow-up delay due to prolonged turnaround time.

The second part of this study tried to identify physician's behavior associated with ordering laboratory tests. Many previous studies reported that the older or more specialized

the physician is, the more test he will order (13,25,26, 27, 28,29,30-37). Our study showed that 60.2% of the physicians are above 40 years and 78.4% of the physicians are using the clinical practice guidelines to choose appropriate tests, and 88.6% are specialized in certain medical field. However, the number of tests they order cannot be obtained through surveys. It would be beneficial if the Information System (IS) Department at HMC track the physicians ordering patterns and ensure they follow the CPGs. Moreover, several studies show the effect of the experience and knowledge in test order; nevertheless, the pattern is not clear as it shows increase, decrease or no effect on some tests requested (13,29,37,38,39). Our study shows that 88.6% of the surveyed physicians are specialists and the majority worked more than ten years as general physicians (40.9%) and as specialists (48.9%). Again, the pattern of order can be followed by the IS.

Alerting physicians about unnecessary tests pre-ordering them alone or with display the previous test results or the ordering guidelines had shown a significant reduction in test ordered (3,40,41,42). Cerner is a new software that physicians are using to order laboratory services in HMC. Unfortunately, 59.1% of the physicians were not being alerted about redundant tests by Cerner. Meanwhile, 67% prefer to be able to get alerted with previous results pre-ordering a redundant test. Moreover, other studies showed a decrease in inappropriate utilization practices when using corollary orders notifications, well-designed test templates and reflex testing protocols (43). Likewise, our study revealed that many physicians at HMC found these features of Cerner useful to choose the right test.

The information available to physicians has a potential influence over their practices. Clinical practice guidelines used to standardize physicians practice are effective to reduce inappropriate test orders (44). Luckily, 78.4% of the clinicians were using such

guidelines. However, a physician needs more updated information. Pathologist interpretations provided evidence for improvement in future test selection (43,46,47). This study showed that 61.4% of the physicians were considering such interpretations valuable which provoke thinking about those sometimes said whether the interpretations were inconsistent or ambiguous. In addition, Laboratory Handbook is an enriched source of information by which laboratories should be communicating with clinicians (43). Despite the efforts done by the lab supervisors to update and maintain their handbooks, 73% of the clinicians were not using them, and 9.1% contemplate them useless. One study emphasized on the need of understanding the care providers' needs and make user-friendly interface while using effective search tools (43). Another important consideration before ordering any test are PPV, NPV, CU and test accuracy (14). Most of the physicians (52.2%) are calculating them in their mind when they think it is needed, while 33% were giving attention to such critical parameters. A common approach to the diagnosis of a new inpatient with vague complaints, like dizziness, is ordering tests in sequence or parallel, which will increase the costs regarding additional tests ordered. The saving will occur by shorting hospital length of stay (14). Most of our study participated physicians (76.1%) prefer to use this approach.

Physician decision is also affected by others' inquiries, assessments, and involvement. If peers are not available, practitioners had shown to order more tests, while peers review and audits had evidenced to reduce the test warrants (48,49,50). Our study showed that physician trusted to ask colleagues about the right test to order, whether often, sometimes or rarely. A real question to ask here is, what if that colleague is ordering many or unrequired tests. Several studies reported the significance of feedback in the reduction

of test utilization (13,51,51,53,54-56,57). Most of the physicians (84%) preferred getting feedbacks about their improper test orders, though, 51% of them had not been contacted at all, and 40.9% were rarely being contacted. This provides a good chance for the laboratory to help physicians order the right test, and guide them to use the laboratory handbook. On the other hand, the percentage of the physicians welcoming the feedback from the laboratory reduced by 11.3% when asked if they prefer the feedback from their chair of the division, although it will be anonymous. The work environment should be welcoming constructive feedback (positive or negative), and use it for the benefit both the hospital and the physicians. Otherwise, destructive consequences will lead to inappropriate workplace behavior, stress, and feedback avoidance (58). A study suggested limiting the search terms for esoteric tests in the computerized provider order entry (part of the information system used by physicians to order tests) to specialists to reduce inappropriate test orders (43). Many surveyed physicians (63.6%) agreed to such suggestion.

As widely known, physicians order test either to diagnose, manage or follow-up their patients. Therefore, it is a must to have a plan in mind of how the results, whether normal, abnormal or ambiguous obtained from the laboratory would be used (14). Favorably, all the physicians were considering the results while ordering. Moreover, the time to get a result must be considered in clinical decision-making, especially when dealing with critically ill patients (14). Using test orders for trauma patients was estimated by Tasse et al. to result in significant cost savings of over \$1.5 million per year (59). In our study, 97.7% of the participants said they consider the time element when ordering a lab test.

On the one hand, several studies showed that awareness of the cost of testing would reduce tests' orders (60-62), while on the contrary, one of the largest randomized trials

showed no significant influence (63). Our results revealed that many of the physicians (67%) were not aware of the cost of testing. Gratefully, more than half (63.3%) said that they would reduce test orderings if the cost were high, instead 70.5% stated that the low-cost test would not affect their ordering practice. Some also responded that low-cost test would increase their orders.

Other factors may drive physicians to order unnecessary tests as adherence to firm protocols, peer-pressure, fear of uncertainty, defensive medicine ...etc. (64). In this study, the main four reasons to order lab tests were ease of ordering (20.9%), the desire for certainty of diagnosis (20.4%), impatience (19%) and patient demand (16.6%). These and other factors (figure51) are equally necessary to induce a real culture change in HMC, with inevitably the help of senior physicians and supervisors to emphasize on the development of reasoning acts and reprimand inappropriate practice (14).

There are many laboratory utilization effective approaches that may encompass education, peer review and feedback, administrative changes, rationing, and financial penalties/rewards, laboratory utilization committees (LUCs), laboratory test formulary, hard stops and approval Systems/Gatekeeping, (1,8,65). Education is essentially continuous time- and labor-intensive efforts that need time and local champions to engage in lectures and guideline dissemination. Effective Peer review and audit is specific and periodic time- and labor-intensive approach, and can be done through different tools such as providing personalized test utilization comments, cost information, peer-ranking regarding lab utilization, and visual senior physicians reviews of current patients to vet appropriateness (13,66,67). Three main administrative changes can be used. First, creating efficient requisition forms is the long-term solution that alters test utilization improper

practices either through form restructuring done by replacing a test with another or modify the listing order of test panels (60,61). Second, remove an inappropriately utilized test from the CPOE “quick pick” menu and standardized templates (64,62). Third, initiate on spot learning and feedback via pop-up reminders of overused or outdated tests once ordered. Also, this step can include self-reflection by an alert asking for justification of the ordered test. This will force a physician to pause and reconsider his order (68). Rationing done by restricting some tests ordered per day per one patient, and this has shown to reduce two-thirds reduction of such orders (69). LUC is supported and approved by hospital admiration or executive committees to improve laboratory utilization practices with more focus in testing by monitoring test orders and new requests, and developing tools to enhance utilization practices. The committee must consist of “clinical pathologists and laboratory medical directors, laboratory administration, financial experts, and clinicians” (1). In several studies, the LUCs succeeded to improve utilization practices (62,70,71). Like medication formularies, laboratories formularies focus on reference laboratory testing and include on-formulary tests which can be ordered by any physician, while off-formulary tests which are of restricted order and can be ordered by a specialist or need an authorized approval. Hard stops focus on routine testing by not allowing the test order to proceed without certain criteria. For example, a physician must call, provide evidence or get approval to override the cancellation or requested test (72). Soft stops are simple alerts to indicate unnecessary tests (1). Approval Systems/Gatekeeping is a system where laboratory medical professional has some authorization to approve the test to be done which showed by Dickerson et al. to save approximately \$20,000 in a 4-week period (23). Monitoring and measuring the effect of any tools used is crucial to sustaining any new

program or system to improve test utilization. Moreover, there are many resources help to establish and support a utilization management program such as Pediatric Laboratory Utilization Guidance Service (PLUGS), Associated Regional and University Pathologists (ARUP), Quest, and clinical laboratory professional societies as American Society for Clinical Pathology (ASCP) collaborating with the American Board of Internal Medicine Foundation to establish Choosing Wisely website to provide good quality resources for utilization management (1).

HMC should use different approaches and tools to develop a comprehensive and long-lasting collaborative program to overcome inappropriate test utilization practices and deliver optimal patient care.

6. LIMITATION

This study has several limitations. First, laboratory supervisors number was small because the total number of HMC supervisors is also small. Second, one nurse had been taken out of the laboratory supervisors survey. Third, one laboratory technologist had been taken out of the physicians' survey. Third, it would have been more accurate to know the ordering pattern from the software the physicians are using. The problem is the confidentiality issues and HMC restricted rules. Finally, the two surveys had not been validated before dissemination to participants, but only extracted from published research articles and reviews.

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