

Superfluous amylase/lipase testing at a tertiary care hospital: a retrospective study

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Citation: Aljomah AS, Hammami M. Superfluous amylase/lipase testing at a tertiary care hospital: a retrospective study. *Ann Saudi Med* 2019; 39(5): 354-358. DOI: 10.5144/0256-4947.2019.354

Received: January 17, 2019

Accepted: June 2, 2019

Published: October 3, 2019

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Funding: None.

BACKGROUND: Measuring both serum amylase and lipase in the setting of acute pancreatitis is not recommended and monitoring changes in amylase and lipase levels after diagnostic results is of little added value. The extent of the two types of superfluous amylase/lipase testing at our institution is unknown.

OBJECTIVE: Explore the extent of superfluous amylase/lipase testing.

DESIGN: Medical record review.

SETTINGS: Tertiary care, teaching hospital.

PATIENTS AND METHODS: We retrospectively reviewed all amylase and lipase tests performed over a recent 12-month period. Amylase tests were considered superfluous if they were ordered with lipase tests at the same time or if they were repeated after diagnostic amylase results. They were considered questionably superfluous if they were repeated alone after non-diagnostic amylase results. Lipase tests were considered superfluous if they were repeated after diagnostic lipase results and questionably superfluous if they were repeated after non-diagnostic lipase results.

MAIN OUTCOME MEASURES: Number and percentage of lipase and amylase tests that were superfluous or questionably superfluous.

SAMPLE SIZE: 23 950.

RESULTS: Superfluous testing was identified in 30.6% of 23 950 amylase/lipase tests and questionably superfluous testing in 12.4%. Of the 7330 superfluous tests, 94.8% were due to simultaneous amylase/lipase testing and 5.2% to repeated lipase testing after diagnostic results. The rate of superfluous and questionably superfluous testing was significantly higher in the inpatient setting compared to emergency department or outpatient settings ($P < .0001$). Of the 6483 amylase tests obtained simultaneously with non-diagnostic lipase tests, only 36 (0.6%) showed a diagnostic result. Furthermore, only 0.7% and 3.6% of amylase tests that were repeated after normal and borderline results, respectively, were diagnostic and 1.1% and 9.3% of lipase tests that were repeated after normal and borderline results, respectively, were diagnostic.

CONCLUSIONS: About one third of amylase/lipase testing appears to be superfluous, mainly due to simultaneous amylase/lipase testing. Since only 0.6% of simultaneous amylase/lipase tests showed diagnostic amylase with non-diagnostic lipase levels, quality improvement initiatives should be directed at reducing this low-value practice. Repeating amylase/lipase tests following normal results is of little value.

LIMITATIONS: Clinical notes and imaging studies were not reviewed.

CONFLICT OF INTEREST: None.

Acute pancreatitis is one of the most frequent gastrointestinal causes for hospital admission and is a financial burden to health care systems.^{1,2} The diagnosis of acute pancreatitis requires two of the following: (1) abdominal pain consistent with acute pancreatitis, (2) serum lipase level (and/or amylase level) greater than three times the upper limit of normal, and (3) characteristic findings from abdominal imaging.³ Current guidelines (American College of Gastroenterology Guidelines,³ American Gastroenterology Association Guidelines,⁴ British Society of Gastroenterology Guidelines,⁵ and the Japanese Guidelines⁶) recommend the use of serum lipase instead of serum amylase in the diagnosis of acute pancreatitis as it has superior specificity and sensitivity and its abnormal levels last longer.^{3,5,7-9} Further, the American College of Gastroenterology guidelines and the American Gastroenterology Association technical review state that measuring both serum amylase and serum lipase is not necessary and that monitoring changes in amylase and lipase levels after diagnostic results is of little added value.^{8,9}

In 2013, the Institute of Medicine reported that “unnecessary services” added \$210 billion to health care spending in the United States, making it the single biggest contributor to waste.¹⁰ Unnecessary laboratory tests are examples of such wasteful services that promoted the Choosing Wisely Initiative of the American Board of Internal Medicine to share new recommendations from the American Society for Clinical Pathology, emphasizing the use of serum lipase instead of serum amylase in suspected acute pancreatitis.¹¹ Nevertheless, the use of both markers appears to still be commonplace. For example, in recent US studies, amylase and lipase were ordered simultaneously in 71% of 10 843 patients¹² and 75% of 13 198 patients.¹³

The main aim of this study was to explore the extent of superfluous amylase/lipase testing at the King Faisal Specialist Hospital and Research Centre (KFSHRC), a tertiary care, teaching hospital in Riyadh. Secondary aims were to assess the frequency of having diagnostic amylase results with simultaneous normal or borderline lipase results and of having diagnostic amylase or lipase results following normal or borderline results during the same clinical encounter.

PATIENTS AND METHODS

We retrospectively reviewed all amylase and lipase tests that were performed at KFSHRC over a 12-month period (01 January 2017 to 31 December 2107). Locations in the hospital where blood samples were drawn and the time, date, and the results of all tests were collected

in an anonymized fashion. Lipase and amylase levels were classified as normal, diagnostic of acute pancreatitis (>3 times the upper limit of normal), or borderline (≤3 times the upper limit of normal). The normal range of amylase and lipase levels at the hospital laboratory were 30-110 U/L and 0-60 U/L, respectively.

Lipase and amylase tests were classified as occurring during the same or a different clinical encounter based on location and time interval between the tests. Locations were classified into outpatient, emergency department, or inpatient. Outpatient tests were considered to belong to different clinical encounters if they were not obtained on the same date, emergency department tests if they were separated by more than 48 hours, and inpatient tests if they were separated by more than 7 days or by tests obtained in the emergency department or outpatient setting. When emergency department tests preceded inpatient tests by no more than 7 days, they were considered to belong to the same clinical encounter.

Amylase tests were considered superfluous if they were ordered with lipase tests at the same time or if they were repeated after diagnostic amylase results. They were considered questionably superfluous if they were repeated alone after non-diagnostic amylase results. Lipase tests were considered superfluous if they were repeated after diagnostic lipase results and questionably superfluous if they were repeated after non-diagnostic lipase results. Otherwise amylase and lipase tests were considered non-superfluous.

We calculated the number and percentage of lipase and amylase tests per location (inpatient, outpatient, or emergency department), per level (normal, borderline, or diagnostic), and per utility (superfluous, questionably superfluous, or non-superfluous). We also calculated the number and percentage of diagnostic amylase tests that were obtained simultaneously with normal or borderline lipase tests and of diagnostic amylase or lipase results that were obtained after normal or borderline results.

RESULTS

A total of 23 950 tests (7293 amylase and 16 657 lipase tests) were performed over a 12-month period. The distribution of tests per setting, utility, and level are presented in **Table 1**. Out of the 23 950 tests, 44.9% were obtained in an outpatient setting, 36.4% in an inpatient setting, and 18.0% in the emergency department. The remaining 0.6% were obtained in other locations (for example, radiology department, dialysis unit, and home healthcare).

Out of the 23 950 tests, 58.0% were simultaneous

amylase/lipase tests, 40.5% lipase-only tests, and 1.4% amylase-only tests. Twenty-two percent of the 23950 tests were repeated in the same clinical encounter. As shown in **Table 1**, 2.7% and 14.5% of amylase tests were diagnostic and borderline, respectively, and 4.3% and 15.7% of lipase tests were diagnostic and borderline, respectively.

Superfluous testing was identified in 30.6% of the 23950 tests and questionably superfluous testing in 12.4%. Of the 7330 superfluous tests, 94.8% were due to simultaneous amylase/lipase testing (68.5% were initial tests and 26.3% repeated during the same clinical encounter) and 5.2% were due to repeated lipase testing after diagnostic results. Of the 2972 questionably superfluous tests, 97.2% were repeated lipase tests after normal or borderline results and 2.8% repeated amylase tests after normal or borderline results.

Most of the superfluous testing occurred in an inpatient setting (51.1% vs 28.3% in an outpatient setting, 20.0% in the emergency department, and 0.6% in other locations). Further, the highest rate of superfluous testing also occurred in the inpatient setting (43.0% vs 19.3% in the outpatient setting, 34.0% in the emergency department, and 29.3% in other locations, $P \leq .0001$).

Similarly, most of the questionably superfluous testing occurred in an inpatient setting (94.9% vs 4.7% in emergency department, 0.4% in outpatient setting, and 0% in other locations) and the highest rate of questionably superfluous testing occurred in the inpatient setting (32.3% vs 3.3% in the emergency department, 0.1% in an outpatient setting, and 0% in other locations). Interestingly, out of the 6483 amylase tests that were obtained simultaneously with non-diagnostic lipase tests, only 36 (0.6%) showed a diagnostic result. Finally, only 0.7% and 3.6% of amylase tests that were obtained during the same clinical encounter after normal and borderline results, respectively, were diagnostic. Similarly, only 1.1% and 9.3% of lipase tests that were obtained after normal and borderline results, respectively, were diagnostic.

DISCUSSION

We found that 1) 30.6% of amylase/lipase tests were superfluous and 12.4% questionably superfluous, 2) almost all of the superfluous tests were due to simultaneous amylase/lipase testing, 3) only 0.6% of amylase tests that were obtained simultaneously with non-diagnostic lipase tests showed diagnostic results, 4) the largest volume and the highest rate of superfluous and questionably su-

Table 1. Distribution of amylase and lipase tests per setting, utility, and level.

	Amylase					
	Superfluous	Utility Questionably superfluous	Nonsuperfluous	Diagnostic	Borderline	Normal
Inpatient	3374	77	69	163	593	2764
Outpatient	2073	1	131	17	278	1910
Emergency	1461	5	43	14	168	1327
Other areas*	44	0	15	3	15	41
Total	6952	83	258	197	1054	6042

	Lipase					
	Superfluous	Utility Questionably superfluous	Nonsuperfluous	Diagnostic	Borderline	Normal
Inpatient	370	2742	2085	499	932	3766
Outpatient	0	11	8546	162	1358	7037
Emergency	8	136	2668	54	316	2442
Other areas*	0	0	91	6	10	75
Total	378	2889	13390	721	2616	13320

Data are number of tests performed. Diagnostic >3× upper limit of normal. *Radiology department, dialysis unit, home healthcare and others.

perfluous testing took place in the inpatient setting, and 5) the yield of repeating amylase and lipase tests after initial normal results was very low ($\leq 1.1\%$).

Superfluous amylase/lipase testing has not been studied before in Saudi Arabia or other Middle Eastern countries. However, our finding of a high rate of superfluous amylase/lipase testing that was mainly due to simultaneous amylase/lipase testing confirms the results of two recent US studies where 71% to 75% of patients had simultaneous amylase/lipase testings.^{12,13} The American College of Gastroenterology guidelines and the American Gastroenterology Association technical review state that measuring both serum amylase and lipase in acute pancreatitis is not necessary.^{8,9} Consistent with the guidelines, we found that it is rare to have a diagnostic amylase result simultaneously with a non-diagnostic lipase result. It is of note that some of these diagnostic amylase results may be false-positive as lipase testing is more specific. Our finding strongly supports the notion that the combination of amylase and lipase is not better than lipase alone in the diagnostic workup of acute pancreatitis. The guidelines^{8,9} further state that repeated measurement of serum amylase or lipase after establishing the diagnosis of acute pancreatitis has limited value in assessing clinical progress or ultimate prognosis. We also found that there is little value of repeated amylase and lipase testing after normal results. However, the yield of diagnostic values after borderline results was 3.6% of amylase and 9.3% of lipase. Serum amylase and serum lipase start to increase within 2-12 hours and 4-8 hours, respectively, after the onset of acute pancreatitis.¹⁴ Since most testing in our study were performed in the inpatient setting, it is likely that some of the first rounds of testing were performed too early in the evolution of pancreatitis.

Unnecessary amylase testing has prompted the Choosing Wisely Initiative of the American Board of Internal Medicine to share the American Society for Clinical Pathology recommendations emphasizing the use of serum lipase instead of serum amylase in suspected acute pancreatitis.¹¹ Akhtar and colleges implemented a best practice computerized alert to minimize simultaneous ordering of serum amylase and lipase; in a 3-month period, simultaneous amylase/lipase testing decreased by 60%.¹³ Jaeger and colleges changed the default status of amylase test from checked to unchecked in the order set for abdominal pain; within a year, simultaneous amylase/lipase testing decreased by 87%.¹² Similarly, removing amylase from common order sets in electronic medical records reduced simultaneous amylase/lipase testing by 15% in a US university hospital¹⁵ and decoupling amylase and lipase and removing

amylase from order entry forms reduced simultaneous testing from 93% to 14% in a US trauma center.¹⁶ It appears that similar quality-improvement initiatives at KFSHRC could be of benefit. Of note, educational intervention alone reduced the simultaneous testing by only 2% in the trauma center study.¹⁶

Quality-improvement initiatives aiming at reducing superfluous amylase/lipase testing resulted in reducing charges by \$135,000 to \$350,000/ year.^{15,16} In our institution, an amylase test cost around SAR 95 (\$25) and a lipase test around SAR 75 (\$20). Thus total cost of amylase/lipase tests in 2017 was around SAR 1,942,110 (\$517,896) (and superfluous tests' cost was around SAR 688,790 (\$183,677)). Eliminating superfluous amylase tests alone would result in saving of around SAR 660,440 (\$176,117) per year (**Figure 1**).

Finally, we have found that the bulk of superfluous testing was obtained in the inpatient setting. Since KFSHRC is a teaching hospital, it is possible that some of the tests were ordered by residents/fellows in training. This suggests that the quality improvement/education initiative should be directed particularly to this setting.

An important limitation of this study is that clinical notes and imaging studies were not reviewed; hence, some of the diagnostic amylase and lipase results may be false positive for the diagnosis of pancreatitis. Further, amylase or lipase tests are occasionally ordered for conditions other than pancreatitis. Thus some of the apparently superfluous tests in our study may have been indicated. However, since the other conditions are

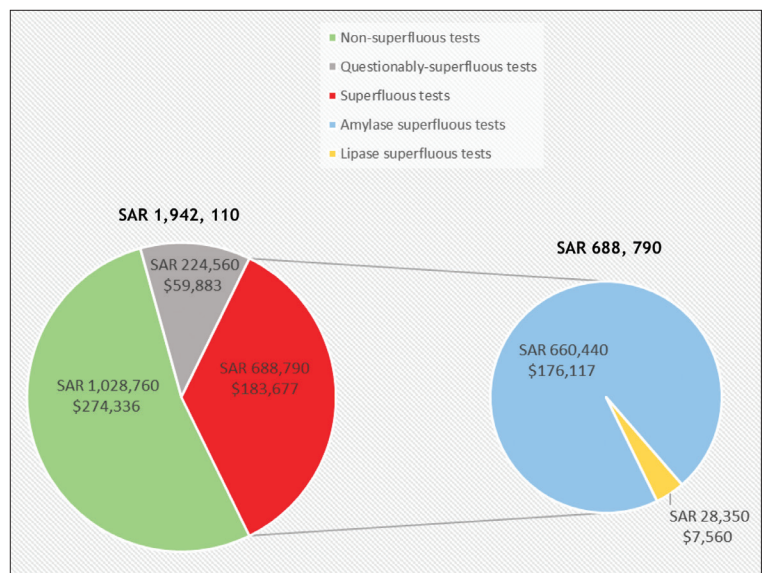


Figure 1. Cost of superfluous, questionably-superfluous, and non-superfluous amylase/lipase tests in KFSHRC in 2017.

relatively rare and since most of the superfluous tests in our study were simultaneous amylase/lipase tests this limitation is not expected to affect our main results and conclusions. Another limitation is that classification of tests as occurring during the same or different clinical encounter was arbitrary and not based on a review of medical records.

In conclusion, about one third of amylase/lipase

testing at a tertiary care hospital appears to be superfluous, mainly due to simultaneous amylase/lipase testing. Given that only 0.6% of simultaneous amylase/lipase tests showed diagnostic amylase with non-diagnostic lipase levels, quality improvement initiatives should be directed at reducing this low-value practice. The introduction of computerized alerts seems an appropriate initial measure to reduce superfluous testing.

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