

# Minimum retesting intervals – application through electronic order forms on common laboratory tests

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## ABSTRACT

Inappropriate ordering of laboratory tests generates unnecessary excess of labour, expenses and waste. Here we present how the laboratory can proactively and effectively manage its workload using minimum retesting intervals implemented in a computerized hospital laboratory test ordering system.

The hospital information system was upgraded with a feature of checking and alerting to inappropriateness of a patient's test request according to pre-set criteria (existence of previous result within a defined time period, and a pending request for the same test). The project was implemented in two hospital wards and results were collected for emergency requests during April 2016.

Overall, 4,094/20,495 requests violated the implemented criteria for the appropriateness of testing and generated alerts. As a consequence, 1,517 requests were dismissed (7% of all requests, 37% of alerted tests). Throughout the study, the total financial savings was 33,394 HRK (approximately 4,300 EUR). The average saving per test was 8.1%.

A restriction of emergency tests requests resulted in substantial effectiveness, suggesting further implementation together with the promotion and education between clinicians and laboratory professionals.

*Key words: minimum retesting intervals, laboratory test ordering, emergency test requests*

## INTRODUCTION

Laboratory testing is important and inevitable part of modern diagnostics and disease management. (1) An appropriate selection of a test repertoire, guided by scientific evidence with an appropriate interpretation of

results, is a key target for both physicians and laboratory professionals. (2) Inappropriate ordering of tests generates unnecessary excess of labour, expenses and waste affecting laboratory budgets and healthcare systems worldwide. (2) Therefore, a laboratory must be proactive in effectively managing its workload in order to provide the best service for patients within defined constraints. (3)

The Department of Laboratory Diagnostics, University Hospital Centre Zagreb, performs about 3.9 million tests per year. During the last 3 years, the number of tests increased yearly by an average of 5%. About 70% of the entire number of tests was requested from hospital wards (inpatients). Inpatient samples are tested in the routine or in the emergency part of the laboratory, depending on the physician's request based on the patient's condition.

The use of electronic medical records and computerized order entries available through hospital information system has an impact on laboratory test utilization (1) However, it opens the possibility for the management of retesting demand based on information technology, including laboratory formulary, order entry design, algorithms and reflex testing protocols, consultancy services and finance based restrictions. (4)

Herein we will describe the use of restriction of electronic order entry based on guideline-established minimum retesting intervals (5) for ten common laboratory tests ordered for inpatients as emergently needed.

## MATERIALS AND METHODS

Laboratory tests are requested by a physician in charge using an electronic order entry form which is part of the hospital in-

formation system (BIS, In2 grupa, Zagreb, Croatia). The hospital information system communicates with the laboratory information system (BIONet LIS, In2 grupa, Zagreb, Croatia) for request and result transfers. For the purpose of this project, BIS was upgraded with a software feature for checking the appropriateness of a request according to entered limitations. A request of a potentially inappropriate test(s) generated alert windows that contained data of a previous order (test name, result, reception time, validation time, defined minimum retesting interval in days and a link to the guideline). The physician should have reconsider each alerted test and, if it was reasonable to perform it, to be confirmed by checking a box and entering an argument in the mandatory field. All activities were registered and different reports could be generated.

The project was approved by the Institutional expert committee and, during February 2016, implemented in two hospital departments: Department of Internal Medicine and Department of Neurology. An adoptive period was considered until the end of March, and the first representative results were collected during April 2016.

Limitations for ten commonly ordered tests were set in BIONet LIS settings. An alert window was generated under two conditions: 1) when a request for a certain test is already made and waiting to be finished in the laboratory; 2) if there is a validated result in the past, within a defined time period for appropriateness of retesting (minimum retesting interval, MRI). Minimum retesting intervals were selected according to the guideline document National Minimum Retesting Intervals in Pathology: A final report detailing consensus recommendations for minimum retesting intervals for use in pathology (5) and customized to meet general requirements for inpatients, as follows: total bilirubin, direct bilirubin,

alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma glutamyl transpeptidase (GGT) – two days; C reactive protein (CRP), complete blood count (CBC), prothrombin time (PT), and activated partial thromboplastin time (APTT) and fibrinogen – one day.

An economic analysis was performed according to the reimbursement fees of Croatian Health Insurance Fund valid for secondary (hospital) health insurance in 2016, expressed in the Croatian currency the Kuna (HRK).

#### Results

During the one-month study period, 20,495 requests were generated for 10 observed tests in two clinical wards. Among these, 16,401 requests (80%) did not violate limitation criteria, but an alert was generated for 4,094 (20%) of all requests, as presented in Table 1. As a consequence of the alert appearance, 1,517 requests were cancelled (7% of all requests, 37% of alerted tests). The percentage of alert generation for total bilirubin, ALT, AST, GGT and CRP was higher than the average by 20%. The percentage of alert acceptance (cancelling requests) was the highest for GGT (51% of alerted requests), followed by ALT, total bilirubin, direct bilirubin and AST, with all of them exceeding the average by 37% of generated alerts (Figure 1). Despite higher than average alert generation, the rate of cancelling CRP orders was below average. Complete

blood count and coagulation test requests were under the average rate of alert generation (Figure 1).

Regarding economic analysis, the total cost of all requested tests throughout this study was 429,581 HRK, and by cancelling 37% of the alerted tests this amount was emergently by 33,394 HRK (approximately 4,300 EUR). The average saving per test was 8.1% (Table 1).

#### DISCUSSION

Available laboratory demand management solutions could be grouped as education, rules aimed at restricting test requests, redesign of request forms, computerised physician order entry and reimbursement models. (3) The advantage of a computerized physician order entry is in using available information systems that could be customized to desirable objectives by entering eligible restriction levels.

Minimum retesting intervals in restricting laboratory test orders were previously applied and described by several authors. Janssens and Wasser implemented control of repetitive testing for 44 tests and the obtained results were a reduction of 0.56% of tests and a 0.33% financial reduction. (6) Waldron et al. achieved reduction in CRP requesting by 12.3% and a financial saving of 29% during a one-year period by reduc-

ing requests with MRI of 48 hours. (7) Lippi et al. obtained a 17% test reduction and a 12.8% cost reduction by implementing a computerized alert system based on MRI for 15 tests (8)

The implementation of restrictions in requesting tests from an emergency laboratory could seem incongruous, but our results showed its substantial effectiveness. Ten commonly requested tests were restricted for reordering using soft criteria adjusted to inpatients. Our result of a 7% overall test reduction and a 8% reduction in financial cost is significant and worthwhile. After starting with these two clinical wards, our project proceeds with implementation throughout the entire University Hospital Centre, also with an extended list of tests.

#### CONCLUSION

The results of this study suggest that software-implemented restriction of emergency test requests based on guideline-established minimum retesting intervals may be effective for limiting the inappropriate use of laboratory tests and may generate economic saving, suggesting further implementation together with the promotion and education between clinicians and laboratory professionals.

Table 1. Emergency test requests after implementation of electronic limitations for inappropriateness of diagnostic testing (data from two clinical wards during one-month period)

ALT, alanine aminotransferase; AST, aspartate aminotransferase; GGT, gamma glutamyl transpeptidase; CRP, C reactive protein; CBC, complete blood count; PT, prothrombin time; APTT, activated partial thromboplastin time.

Test	Without alert	Alert generated		Total requests	Cost per test (HRK)	Cost of all requests (HRK)	Saving	
		and ignored	and accepted				(HRK)	(%)
Total bilirubin	1120	188	152	1460	11.55	16863	1755.6	10.4
Direct bilirubin	377	45	34	456	12.65	5768.4	430.1	7.5
ALT	1246	216	189	1651	11.55	19069.05	2182.95	11.4
AST	757	189	130	1076	11.55	12427.8	1501.5	12.1
GGT	1164	184	189	1537	28.6	43958.2	5405.4	12.3
CRP	2678	824	371	3873	26.4	102247.2	9794.4	9.6
CBC	2442	258	94	2794	36.85	102958.9	3463.9	3.4
PT	2567	302	134	3003	24.75	74324.25	3316.5	4.5
APTT	2089	190	119	2398	24.75	59350.5	2945.25	5.0
Fibrinogen	1961	181	105	2247	24.75	55613.25	2598.75	4.7
Total	16401	2577	1517	20495		492581	33394	8.1

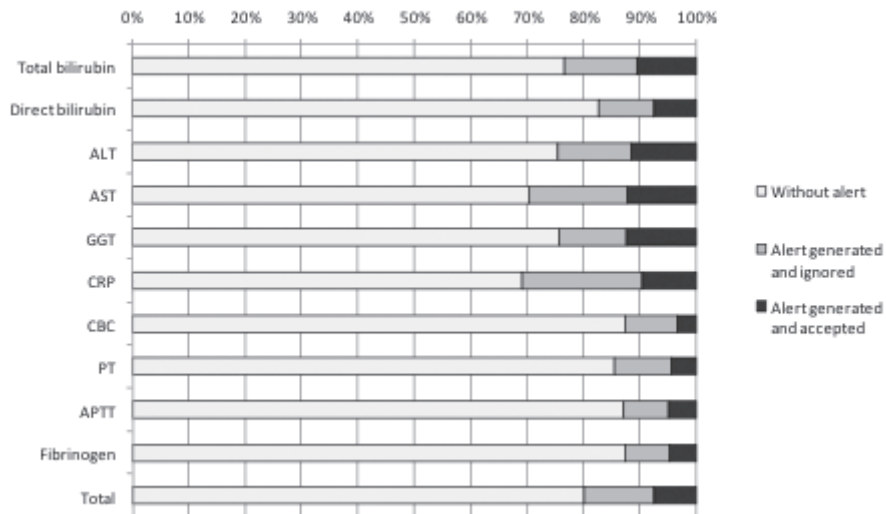


Figure 1. Percentage of emergency laboratory test requests with no alert, alert ignored or dismissed requests due to implementation of electronic limitations for inappropriateness of diagnostic testing. ALT, alanine aminotransferase; AST, aspartate aminotransferase; GGT, gamma glutamyl transpeptidase; CRP, C reactive protein; CBC, complete blood count; PT, prothrombin time; APTT, activated partial thromboplastin time.

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