Letter to Editor

The experience of Careggi Hospital (Florence) regarding Not Received Samples (NRS): a pilot study of Risk Management in the Clinical Laboratory

G. TROIANO[1], N. NANTE[1], A. FANELLI[2], G.M. ROSSOLINI[2], P. PECILE[2], P. BORDONARO[2], B. PERUZZI[2], M. LO RUBBIO[2], T. TANINI[2], C. DURANTI[2], G. PICCINNO[2], F. NICCOLINI[2]
[1] Department of Molecular and Developmental Medicine, University of Siena, Italy; [2] Careggi Hospital, Firenze, Italy

Keywords

Laboratory • Risk management • Pre-analytical phase

Dear Editor,
In laboratory medicine, errors and their possible impact on patient safety have become an increasingly important problem [1, 2].
The so-called pre-analytical phase includes patient identification and sample identification, collection and transport to the laboratory, each of which is a potential source of error [2-6]. Indeed, the pre-analytical phase is not directly controllable by the laboratory, and involves many operators [1, 7, 8].
A typical error in the pre-analytical phase is the so-called "Not Received Sample" (NRS): i.e. following a computerized test request, the sample is not delivered to the laboratory. In Careggi Hospital (Florence) we decided to conduct a multi-step pilot study in order to: i) establish the magnitude of the phenomenon; ii) identify possible determinants.

Phase 1

From 9 to 15 April 2018 (Monday-Sunday) we used the laboratory management software in order to extract the data on NRS in that week. During the study period, 19,521 exam requests were made; 735 (3.7%) were NRS. Of these, 551 (74.9%) concerned the General Laboratory, 84 (11.4%) the Laboratory of Microbiology and Virology, and the remaining 13.6% other laboratories. The highest percentage of NRS was found on Sunday (9.9% of requests) and the lowest on Monday and Tuesday (3.7%).
The wards that generated the most NRS were the Emergency Room (37%), Short-Stay Observation - SSO (5%), and Cardiological Sub-intensive Care and Hospitalization (5%).
Of the NRS documented, 40% were requested in a situation of emergency, 25% in urgency, 35% routinely. The requests that displayed the highest frequency of NRS were for aspartate aminotransferase (AST) (13%), blood count (10%), urea (8%) and glucose (7%) tests. In the microbiological field, the most common NRS concerned stool culture examinations (3% of the total), followed by blood cultures.

Phase 2

A random survey was carried out in June 2018 (June 22, 26, 27). A doctor from the hospital's medical direction questioned the nursing coordinators (or nurses) that collected the samples in the morning (who usually stop working at about 1.00 p.m.) as to the possible causes of each NRS. These interviews were conducted around 12.00 noon, immediately after extraction of the daily NRS (requests for which were inserted between 7:00 a.m. and 9:00 a.m.) from the central database. All the wards that generated a significantly higher number of NRS (on the day considered) were included in the study (on average 4-5 wards per day, avoiding repeat interviews in the same ward, if possible).
In this phase, 159 NRS were identified; the personnel interviewed reported that the causes of NRS were: "sample regularly collected and sent" (53%), "sample not collected" (26%), "sample collected but not yet sent" (8%), and "other causes" (13%).

Phase 3

On 17-18 July 2018, 4 wards were randomly selected from among those that had generated the most NRS in phase 2. With the help of the nursing coordinators in these 4 wards, the outgoing samples (between 8:00 a.m. and 12:00 a.m.) and the samples that reached the laboratory were directly verified, and these data were compared with those from the laboratory management software. The choice to widen the time-window derived from the necessity to limit the number of samples sent in late (the so-called "samples collected but not yet sent"), which cannot strictly be considered real NRS (and which, in phase 2, accounted for almost 50% of the "other causes").
During phase 3, the number of samples collected and the number of samples that reached the laboratory were identical.
The first phase revealed that, in Careggi Hospital, NRS constituted around 4% of the requests made,

https://doi.org/10.15167/2421-4248/jpmh2020.61.1.1218

and that their percentage increased on Saturday and Sunday. This is in line with what is reported in the literature; indeed, a study conducted in 2010 showed that medical and nursing errors (including laboratory errors) increased at night and during weekends [9]. The main factors involved in this kind of error are, we suppose, the reduced number of personnel (at night and at weekends), the patient load, sleep deprivation, and work stress [10].

The distribution of NRS in the wards is probably related to the type of request. Indeed, the rapid transfer of patients in critical conditions could mean that some samples are requested but not collected, as the patient has already been transferred to another ward (e.g. from the E.R. to the Intensive Care Unit, or to the operating room). This conviction is partially supported by the findings of Salvagno et al., in whose 2008 study most NRS were generated in intensive care units and in medical and clinical departments. However, it should be noted that, in their study, pre-analytical errors mainly involved pediatric wards; as Careggi Hospital has no pediatric wards, this comparison must be made with appropriate caution [11].

As for the type of analysis, stool culture requires particular attention, as sampling depends on the patient's ability to evacuate.

The second phase of our study allowed us to document the opinions of health workers, especially nurses. According to their answers, the problem of NRS is due to the loss of samples on the way to the laboratory. According to the authors, however, it is more probable that samples are not collected because they are considered unnecessary; this hypothesis is supported by the fact that the other laboratory exams were regularly performed in every case and the results were sent to the wards. Moreover, the health personnel affirmed that the second most frequent cause of NRS was that samples were not collected for various reasons, denoting a probable problem of incorrect/useless exam requests.

We tried to clarify these doubts in Phase 3, from which it emerged that "sample loss" was a relatively rare event.

The three points of observation (those of the laboratory, health workers and medical direction) constitute the main strength of this study, as they provided a complete overview of the phenomenon of NRS. Admittedly, the methodology used (especially in phase 2) was a weak point, as it was based only on the memory of the personnel interviewed; however, this approach was unavoidable, given the lack of an electronic system (with barcodes) for tracing the single steps (collection, storage, transport, arrival at the laboratory).

Although the "sample loss" is a relatively infrequent event, our study highlighted an economic problem, i.e. the need to manually update the database daily in order to distinguish between "lost sample" and "wrong request". We would like to extend our study to a larger sample and we encourage other colleagues to use this multiple approach in order to investigate the phenomenon of NRS in their own environments. Finally, sensitizing health workers to this problem may result in more careful and appropriate exam requests.

Acknowledgements

Funding sources: this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

GT, AF had the idea of the study, wrote the article; CD, GP contributed to data collection; NN, GMR, PP, PB, BP, MLR, TT, FN helped to conceptualize the ideas.

References

[1] Periccioli A, Caldarelli G, Bocci G, Troiano G, Nante N , Errori nella fase preanalitica di laboratorio: valutazione e gestione. Mondo Sanitario 2018;6-7:37-46.

[2] Serafini A, Troiano G, Franceschini E, Calzoni P, Nante N, Scapellato C., Use of a systematic risk analysis method (FMECA) to improve quality in a clinical laboratory procedure. Ann Ig 2016;28:288-95. https://doi.org/10.7416/ai.2016.2108

[3] Bonini PA, Plebani M., Ceriotti F, Rubboli F. Errors in Laboratory Medicine. Clin Chem 2002;48:691-8.https://doi.org/10.1093/clinchem/48.5.691

[4] Howanitz PJ. Errors in Laboratory Medicine. Practical lessons to improve patient safety. Arch Pathol Lab Med 2005;129:1252-61. https://doi.org/10.1043/1543-2165(2005)129[1252:EILMPL]2.0.CO;2

[5] Donald Y. Conveying the importance of the pre-analytical phase. Clin Chem Lab Med 2003;41:884-7. https://doi.org/10.1515/CCLM.2003.133

[6] Wiwanitkit V. Types and frequency of preanalytical mistakes in the first Thai ISO 9002:1994 certified clinical laboratory, a 6 - month monitoring. BMC Clin Pathol 2001;1:5. https://doi.org/10.1186/1472-6890-1-5

[7] Lippi G, Guidi GC, Mattiuzzi C, Plebani M. Preanalytical variability: the dark side of the moon in laboratory testing. Clin Chem Lab Med 2006;44:358-65. https://doi.org/10.1515/CCLM.2006.073

[8] Masotto M, Brivio R, De Vito G, Villa CE, Ausili D. Gli errori preanalitici nel prelievo ematico: uno studio osservazionale sulle modalità di raccolta dei campioni e sugli esiti di laboratorio. Assist Inferm Ric 2015;34:76-85. https://doi.org/10.1702/1942.21102

[9] Miller AD, Piro CC, Rudisill CN, Bookstaver PB, Bair JD, Bennett CL. Nighttime and weekend medication error rates in an inpatient pediatric population. Ann Pharmacother 2010;44:1739-46. https://doi.org/10.1345/aph.1P252.

[10] Ramadan MZ, Al-Saleh KS. The association of sleep deprivation on the occurrence of errors by nurses who work the

night shift. Curr Health Sci J 2014;40:97-103. https://doi.org/10.12865/CHSJ.40.02.03

[11] Salvagno GL, Lippi G, Bassi A, Poli G, Guidi GC. Prevalence and type of pre-analytical problems for inpatients samples in coagulation laboratory. J Eval Clin Pract 2008;14:351-3. https://doi.org/10.1111/j.1365-2753.2007.00875.x

Received on February 27, 2019. Accepted on February 5, 2020.

Correspondence: Gianmarco Troiano, University of Siena, Department of Molecular and Developmental Medicine, via A. Moro 2, 53100 Siena, Italy - E-mail: gianmarco.troiano@student.unisi.it

How to cite this article: Troiano G, Nante N, Fanelli A, Rossolini GM, Pecile P, Bordonaro P, Peruzzi B, Lo Rubbio M, Tanini T, Duranti C, Piccinno G, Niccolini F. The experience of Careggi Hospital (Florence) regarding Not Received Samples (NRS): a pilot study of Risk Management in the Clinical Laboratory. J Prev Med Hyg 2020;61:E6-E8. https://doi.org/10.15167/2421-4248/jpmh2020.61.1.1218