Opinion Paper

Reflective testing: adding value to laboratory testing

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Abstract

Reflective testing is a procedure in which the laboratory specialist adds additional tests and/or comments to an original request, after inspection (reflection) of the results. It can be considered as an extension of the authorization process where laboratory tests are inspected before reporting to the physician. The laboratory specialist will inevitably find inconclusive results, and additional testing can contribute to make the appropriate diagnosis. Several studies have been published on the effects of reflective testing. Some studies focus on the opinion of the general practitioners or other clinicians, whereas other studies were intended to determine the patient’s perspective. Overall, reflective testing was judged as a useful way to improve the process of diagnosing (and treating) patients. There is to date scarce high quality scientific evidence of the effectiveness of this procedure in terms of patient management. A randomized clinical trial investigating this aspect is however ongoing. Cost effectiveness of reflective testing still needs to be determined in the future. In conclusion, reflective testing can be seen as a new dimension in the service of the clinical chemistry laboratory to primary health care. Additional research is needed to deliver the scientific proof of the effectiveness of reflective testing for patient management.

Keywords: adding on tests; primary health care; reflective testing.

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Background

The core business of the clinical laboratory is to provide results of tests requested by physicians and other health care workers. The task of the laboratory can be defined in broader terms – to help solve diagnostic problems. In the post-analytical phase, laboratory professionals can add value over the purely analytical service. Their knowledge could be used in the interpretation of laboratory test results (1). It is no exception that in a laboratory examination of a patient, abnormal results may be found that could indicate some unexpected pathology. Recognition and interpretation of abnormal results by the laboratory specialist may be helpful for physicians and patients. Examples of disorders typically recognizable by distinct laboratory findings are hemochromatosis, m-proteins, hyperparathyroidism, vitamin B12 deficiency, thalassemia, hepatitis or Gilbert’s syndrome. The laboratory specialist can take other available (medical) information into account (e.g., age, gender, previous laboratory test results, and clinical information) when interpreting abnormal test results and determine whether additional tests are indicated. In most cases, these tests may be performed with the patient’s material already being available in the laboratory. Comments can be added to the report to serve the requesting physician. This process has been called reflective testing (2).

Since the practice of reflective testing is not a common procedure, we recently launched a website (www.reflectivetesting.com) in order to inform other laboratory specialists in detail about this procedure (3). With the support of the European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) Working Group on Guidelines, this website has been edited and translated into English.

Reflective and reflex testing

The term reflective testing was chosen because it is discretionary and based on the clinical judgement (reflection) of a laboratory specialist regarding interpretation of laboratory results. Reflective testing is different from reflex testing (also called protocol testing), in which a predetermined test protocol is automatically completed. Examples are the addition of free thyroxin (T4) when thyroid stimulating hormone (TSH) is abnormal, or free prostate specific antigen (PSA) in case of an increased level of total PSA.

However, in cases with multiple abnormal test results, it is difficult to incorporate additional testing into an automated protocol. Considering the addition of appropriate tests is not a simple process, and requires professional, medical experience.
combined with the knowledge of patient characteristics. Although a laboratory specialist might be dependent on the limited information on the request form of a general practitioner, the ongoing development of the electronic patient record allows better assessment of the clinical status of the patient. An incorporated filter in the laboratory information system [based on range- or delta checking (4)] can facilitate the selection of reports that are suitable for assessment.

An important point of attention is the fact that both reflective and reflex testing can be executed in contemporary clinical chemistry laboratories. Reflective testing was introduced to 155 general practitioners in the area of our hospital in June 2006 concerning only a small selection of patients. From our own database it has been shown that in 10%–15% (64/512; average over a 20-day period) of the daily reports abnormal test results are observed that need evaluation by the laboratory specialist (5). Additional tests and/or comments are added in 2%–3% of the daily reports (270 over a 20-day period), mainly from primary health care requests Reflex testing is also daily routine in our laboratory, e.g., diagnosing patients with suspected anemia. Using a single blood sample, reflex diagnostics is being used to elucidate the cause of the anemia. A patient-specific, interpretive comment is added to complete the report.

**Studies on the effect of reflective testing**

Paterson and Paterson (2) were the first to study reflective testing quantitatively. They investigated the effect of adding on either 25-hydroxyvitamin D or total iron binding capacity in combination with the percentage of transferrin saturation, in order to confirm vitamin D deficiency or hemochromatosis, respectively. The number of add-on tests needed to obtain a diagnosis (NND: number needed to diagnose) turned out to be 4.3 for vitamin D deficiency and 18.8 for genetic hemochromatosis. They highlighted the value of reflective testing to the requesting clinician in three respects: to help exclude a diagnosis, to expedite a diagnosis that is fairly obvious, and to obtain a diagnosis when the original set of results is equivocal. In another study, the impact and effectiveness of introducing reflective and reflex testing of magnesium in severe hypokalemia was investigated (6). Measurement of magnesium in patients with a potassium concentration \( \leq 2.5 \) mmol/L was consecutively studied during three periods of 6 months (baseline, reflective testing, reflex testing). Diagnosis of hypomagnesemia significantly increased from 7.7% (4/52) to 43.1% (31/72) and 69.3% (52/75) with reflective and reflex testing, respectively. It was concluded that in this biochemical scenario reflex testing was more effective than reflexive testing. The clinical utility of reflex and reflective testing was also investigated by Srivastava and co-workers (7). Five scenarios were prospectively studied for one year: vitamin D deficiency, hypomagnesemia, hypothyroidism, hyperthyroidism and hemochromatosis. The main message was that reflex and reflective testing are complementary strategies. Reflex testing is recommended in scenarios where high efficiency (low NND) can readily be achieved. The contribution of reflective testing is comparatively greater when more complex factors need to be considered (e.g., to diagnose hemochromatosis).

**Opinion of professionals and patients**

Darby and Kelly (8) conducted a survey to elicit the service users’ opinion of reflective testing. Ten clinical scenarios, each involving the possible addition of a specific test, were circulated to both hospital doctors and general practitioners. The four response options were to add further tests, phone the clinician and discuss the case, add a comment to the original results (without consultation) or do nothing. It was concluded that reflective testing is generally welcomed by the doctors, provided that the nature and implications of the specific test are taken into consideration. The results of this study were confirmed in a Dutch study, with comparable clinical scenarios (5, 9). A difference with the former study was that the doctors participating in the survey in The Netherlands were not used to reflective testing as a routine service. Nevertheless, the results were remarkably similar to the British study: reflective testing was judged to be useful by the responding general practitioners in 99% (148/150) of the cases (5, 10). In 53% (80/150) of the cases reflective testing was reported to have had an effect on the policy of the general practitioners, in terms of further diagnostics, (change of) medication or referral to a specialist. The high response rate of the general practitioners (87%; 77/89) strengthens the validity of these data and it may be concluded that reflective testing is considered to be useful. Another study investigated the influence of reflective testing on the assessment of clinical case reports by general practitioners (11). A list of 13 cases was prepared and sent to 56 local general practitioners (which are used to the procedure of reflective testing including interpretative comments) and 31 general practitioners linked to the hospital in Den Bosch (which are not familiar with reflective testing). The general practitioners were asked about their working hypothesis and subsequent action(s) they would take (e.g., additional laboratory diagnostics, referral to specialist, medication, other follow-up). The lists were judged by their agreement with the suspected diagnosis as determined by the laboratory specialist after adding additional tests. The results showed a better concordance between the suspected diagnosis of the laboratory specialist and the actions suggested by the general practitioners if the general practitioners were familiar with reflective testing (50.8% vs. 38.2%). In conclusion, reflective testing in primary care had resulted in a learning effect by general practitioners.

Paterson et al. (12) conducted a study on patients attending a general practice or a hospital outpatient clinic. They were asked their views about the practice of add-on testing by the laboratory specialist. A large majority of patients favored an approach in which relevant additional tests are performed without consulting the requesting clinician or patient first. This is a clear indication that most patients are content to let professionals add on relevant tests if this is felt to be in their interest.
Interpretative comments

Several studies have been published on the influence of providing patient-specific interpretative comments, without additional testing. Barlow conducted a survey among general practitioners and nurse practitioners to analyze whether they found biochemistry comments on reports helpful. Clinical comments were added to most endocrine sets of results, glucose tolerance test results and other miscellaneous test results where interpretation is thought to be of help. There was overwhelming support for commenting on tests, and most responders would like to see comments on a greater range of tests (13). In an additional survey, it was asked whether the comments actually had influenced patient management. In summary, it was concluded that in at least 75% of the cases, comments either helped or influenced patient management (14). In a survey studying the value of narrative interpretation of complex coagulation test panels, physicians indicated that in approximately 80% of the cases the comments saved them time and/or improved the diagnostic process (15). Further documentation supporting the need for interpretative comments was provided by a survey in the US. It was shown that nearly one in four primary care physicians reported that the scope of care they were expected to provide was greater than it should be (16). Among the specialists in the survey, more than one in three (38%) reported that the complexity or severity of patients’ conditions at the time patients were referred to them by primary care physicians was greater than it should be. Additional help from the laboratory specialist (by means of adding interpretative comments to test results ordered by general practitioners) could be an important option to tackle this problem.

It can be argued that interpretative commenting is an important part of the procedure of reflective testing. In case of deviating laboratory test results, the laboratory specialist evaluates the results and decides to add one or more tests. Most of the time, the report is completed by an interpretative comment to guide/assist the requesting physician.

Limitations and further research

Several surveys and (observational) studies have been published on different aspects of reflective testing and most conclude positively regarding this intervention. However, these are not considered to present scientific evidence that reflective testing is related to an improved clinical outcome. A randomized trial investigating this aspect has recently been started (17). Preliminary data show that reflective testing in patients resulted in more adequate actions, compared to controls with standard care [42% (22/52) vs. 27% (9/33), respectively] (18).

Another issue is the inter-individual variation between laboratory professionals, as different individuals can have different approaches. It has been shown elsewhere, that the variation between laboratories in the process of authorization of reports is large (19, 20). The greatest variation between laboratories occurred in the number of results reviewed in the clinical validation queue. This varied from 5% to 100%. The use of post-analytical external quality assessment (e.g., asking laboratory specialists to comment on case histories and distribute feedback reports describing their performances afterwards) might help to reduce the variance of post-analytical laboratory practice in the future (21, 22). Establishing an external quality assessment for laboratory post-analytical activities could be considered when reflective testing is initiated.

Reflective testing involves the extra costs of additional tests and personnel time. However, adding tests to an existing order is usually cheaper than a second blood sampling. Cost savings could also be anticipated due to faster determination of a diagnosis, or by the prevention of making a wrong diagnosis or performing unnecessary tests. Such cost-benefit analysis is complicated, and the cost effectiveness of reflective testing has not yet been determined.

Conclusions

Reflective testing can be seen as a new dimension in the service of the clinical chemistry laboratory to primary health care. Data show that general practitioners generally appreciate this service. They consider reflective testing as useful and in more than half of the cases this has resulted in subsequent diagnostic testing, (change of) treatment or referral to a specialist. Additional research is needed to deliver the scientific proof of the additional value of reflective testing in primary care for patient management and to determine the cost-benefit of the procedure. Formal advice on this matter is also missing.

Conflict of interest statement

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References