Editorial

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Shaping the digital transformation of laboratory medicine

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Introduction

Information and communication technologies (ICTs) already have a profound impact on laboratory medicine. On the one hand, these new methods render new analyses possible. Especially, tests from fields such as genomics or proteomics require advanced methods of data analysis. On the other hand, ICT changes the way laboratory results are used and reused. The various stakeholders of a healthcare system increasingly exchange medical data electronically. Toward this end, a secure telematics infrastructure is being built in Germany. Moreover, insurers, hospitals and other entities store medical data in electronic patient records. These projects promise that laboratory results are always available at the point of need. Moreover, various research projects also aggregate and analyze medical data on a new scale to gain new insights. The German medical informatics initiative is one of the largest projects and involves nearly all German medical universities [1]. Results from laboratory medicine again play a prominent role because they are usually electronically available and contribute considerably to a diagnosis. This special issue of the Journal of Laboratory Medicine illuminates the various medical, technical and social challenges and opportunities that ICT poses for laboratory medicine.

Challenges

New diagnostic tests produce so much data that processing becomes difficult. Especially, the new so-called “-omics” disciplines require new ways to handle this information. In his article, Eck reviews some of these challenges and proposes some solutions [2]. Besides tests producing a large amount of data at a single point in time, other tests such as continuous blood glucose concentration measurements produce streams of laboratory data that require new approaches. Their continuous nature of data requires new ways of transmittance. Freckmann and Mende point out how the interpretation of these tests can be improved if other data sources such as physical activities or carbohydrate intake are also considered [3].

The traditional laboratory workflow starts with a physician ordering the test and ends with the same physician receiving and interpreting the result [4]. ICTs can transmit data and thereby expand the group of recipients of laboratory reports. Other physicians, patients and stakeholders can attempt to interpret the results, even outside of a medical treatment context. Orth et al. describe some of the arising challenges in more detail [5]. The distribution of legal obligations between the involved parties is discussed by Gassner et al. [6].

Working solutions

In their review, Dahlweid et al. introduce a set of ICT tools that is used in Switzerland to render laboratory data interoperable [7]. The authors also describe the Insel clinical data warehouse in Bern. In this platform, laboratory results can be analyzed for research, patient treatment and hospital operations. In Austria, laboratory data and other medical information are stored in the Austrian electronic health record (ELGA). In their article, Sabutsch and Weigl describe the process of implementing ELGA, and how this project now connects general practitioners, pharmacies, infirmaries, care facilities, ambulances and other healthcare institutes [8].

Both articles agree that a common language is a prerequisite for data exchange. Another article sheds light on several terminologies for laboratory results [9]. Kammergruber and Durner point out how laboratory information management systems need to improve to meet future requirements [10].

Shaping the transformation

The increased use of ICT in laboratory medicine is not risk-free but promises great advantages for patient care and
research. Laboratory medicine and medical informatics need to cooperate to make this transformation successful.

Laboratory medicine needs to increase efforts to make results comparable. Traceability to reference methods and reference materials is a prerequisite for this. Panteghini estimates that only approximately 65 analytes are metrologically traceable to reference standards and therefore are likely to produce comparable results [11]. The External Quality Assessment (EQA) scheme plays a key role in the efforts to improve standardization and has shown some successes [12]. This issue describes another innovative quality control project that uses ICT to maintain harmonization and standardization of measurements [13]. Even when analyses are traceable, comparability might be affected by factors such as pre-analytic differences, the selectivity of the analytical method or interfering factors. In the post-analytic phase, variations in reporting might contribute to further errors and misunderstandings. Therefore, the Informatics External Quality Assurance Project in Australia aims to verify that electronically transmitted laboratory medicine results conform to quality standards [14]. All factors contributing to comparability of analytical results can be treated in a common model by the concept of measurement uncertainty as specified by the Guide to Expression of Uncertainty in Measurement [15]. Therefore, this concept will likely gain more importance although many practical issues are still under debate [16, 17].

When exchanging and storing laboratory data, no information required for correct interpretation should be discarded prematurely. However, overly complex information models that pay too much attention to subtle differences between analytical methods quickly become unusable. Here, medical informatics needs to strike the right balance. Specialists from medical informatics can further facilitate correct interpretation by designing electronic laboratory reports with visual aids [18]. When analyzing laboratory data, robust methods need to be able to deal with non-standardized measurements. Often, not only the absolute value but also the dynamic change of a parameter is important [19]. Tools need to be developed to establish the temporal correlation between laboratory value changes and other medical events [20]. Because results from many analyses are log-normally distributed, extreme values are relatively common and these ICT tools need to be robust with regard to outliers [21].

We hope that this issue of the Journal of Laboratory Medicine can contribute to a better understanding between laboratory medicine and medical informatics. Both disciplines would benefit, but the main advantage would arise for the patients.

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