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Cross-border teleradiology—Experience from two international teleradiology projects

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ABSTRACT

Teleradiology aims to even radiologists' workload, ensure on-call services, reduce waiting lists, consult other specialists and cut costs. Cross-border teleradiology widens this scope beyond the country borders. However, the new service should not reduce the quality of radiology. Quality and trust are key factors in establishment of teleradiology. Additionally there are organizational, technical, legal, security and linguistic issues influencing the service. Herein, we have used experiences from two partially European Union funded telemedicine projects to evaluate factors affecting cross-border teleradiology.

Clinical partners from Czech Republic, Denmark, Estonia, Finland, Lithuania and the Netherlands went through 649 radiology test cases in two different teleradiology projects to build trust and agree about the report structure. Technical set-up was established using secure Internet data transfer, streaming technology, integration of workflows and creating structured reporting tool to overcome language barriers.

The biggest barrier to overcome in cross-border teleradiology was the language issue. Establishment of the service was technically and semantically successful but limited to knee and hip X-ray examinations only because the structured reporting tool did not cover any other anatomical regions yet.

Special attention has to be paid to clinical quality and trust between partners in cross-border teleradiology. Our experience shows that it is achievable. Legal, security and financial aspects are not covered in this paper because today they differ country by country. There is however an European Union level harmonization process started to enable cross-border eHealth in general.

1. Introduction

Well-established standards in diagnostic imaging and high bandwidth connections inside and between the radiology departments have changed the way how the radiology service functions. Progress in information and communication technology has created tools for re-engineering traditional radiology workflow. Picture archiving and communication system (PACS), radiology information system (RIS) and electronic patient record (EPR) have enabled radiologists to use matrix workflow management, where patient data and images can be accessed at any time and any location if the radiologist is entitled to do so. Those achievements have potential to allow quick development of teleradiology services.

Teleradiology is the transmission of images and associated data between locations for the purpose of primary interpretation or consultation and/or clinical review [1]. Currently teleradiology is widely used as a complementary option in the present clinical radiology workflow. Remote reporting of images is well accepted in most of countries. Teleradiology is used in local or regional health care to rationalise on-call services, to improve the reporting capacity of health care organizations, to balance the workload across radiologists or domestic health care institutions, and to link remote imaging facilities with a central hospital. For image transmission secure point-to-point connections are used. Despite the benefits listed above and the fact that teleradiology has been practised in European Union (EU) in certain extent for more than two decades the real boost of cross-border service has not been achieved. Currently there are only few commercial companies in EU providing cross-border teleradiology service. The number of reported exams

Abbreviations: PACS, picture archiving and communication system; RIS, radiology information system; EPR, electronic patient record; VPN, virtual private network; SRT, structured multilingual reporting tool; DICOM, digital imaging and communications in medicine; SNOMED, systematized nomenclature of medicine; CT, computed tomography; MRI, magnetic resonance imaging; PET-CT, positron emission tomography-computed tomography.

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is around 100 000–200 000 per year compared to approximately 500 million exams performed annually in EU.

Historically teleradiology was used in 1980s as a second opinion service to give interpretation of images from remote locations [2]. In the last decade the primary reporting has replaced the second opinion. This has turned the focus from technical integration and service organization to clinical quality, legal and reimbursement issues. The same requirements apply to cross-border teleradiology. It is of utmost importance that use of cross-border teleradiology does not in any way reduce the quality of radiology services provided to the citizen. This means common agreement about licensing, accreditation and registration of telemedicine services and professionals, as well as agreement about liability, reimbursement and jurisdiction.

The main incentive of the health care provider to use cross-border reporting is to solve the shortage of reporting resources in the daily production. This trend is amplified by the expectation to get reporting with lower costs. Those incentives are not necessarily shared by radiologists. There is an uneven distribution of skilled radiologists in EU and in other countries. The number of radiologists currently working in the European countries is between 60 and 250 per one million inhabitants. In Japan the corresponding number is 36 [3]. In EU the relative surplus of radiologists is mainly in the new member states. The fact that radiologists' income in those countries is in certain extent lower makes outsourcing pressure even more inevitable.

The cross-border teleradiology service can be established between two institutions (point-to-point connection) or using a wider radiology network (many-to-many connection or a radiology eMarketplace). The former one is a classical connection where two health care institutions are securely connected to each other. There is no access to a third party. Many-to-many connection is achieved by using a central node or platform through which several health care providers can securely get connected.

The purpose of this study was to find out the possible challenges in building a cross-border teleradiology service like semantic interoperability, acceptance and quality assurance, and also to work out the good opening that could be gained from an eMarketplace approach.

We have used our experience on two partially EU funded telemedicine projects – Baltic eHealth and R-Bay – to evaluate factors affecting cross-border teleradiology. Legal, security and financial aspects are not covered because today they differ country by country. There is however an EU level harmonization process started to enable cross-border eHealth in general.

2. Materials and methods

2.1. Cross-border projects and the technical set-up

We studied 649 cross-border teleradiology cases in two different teleradiology projects—Baltic eHealth and R-Bay. This resulted in 4 different clinical set-ups. There was one second opinion service (The Netherlands–Czech Republic) and three primary reporting services (Denmark–Estonia; Denmark–Lithuania; Finland–Estonia). The size of the hospitals participated in the projects varied from 230 (Czech Republic) to 1100 (Lithuania) beds affiliating from 585 (Czech Republic) to 9500 (the Netherlands) employees.

The Baltic eHealth project was conducted from 2004 to 2007 under Interreg IIIB program [4]. During the project more than 200 hospitals from Denmark, Sweden, Norway, Estonia and Lithuania were connected into one dedicated secure IP-based network. Three hospitals from Denmark, Estonia and Lithuania used the network to establish the cross-border teleradiology service. X-ray images taken in Denmark were reported in Estonia and Lithuania. There were altogether 150 exams reported.

In Baltic eHealth we established the cross-border teleradiology service between Denmark and Estonia as well as between Denmark and Lithuania by using a point-to-point connection between the institutions. This is a classical connection where two health care institutions are securely connected to each other. A web based viewing and reporting platform was used. The selected examinations were sent from the local PACS to the intermediate teleradiology archive. Streaming technology was used for image viewing [5]. The request was copied from the local RIS to the teleradiology reporting platform and the final report was also transferred manually back to the local RIS. There was no technical integration between the local systems and teleradiology platform. No access to a third party was created.

The R-Bay project was a European eTEN market validation project [6]. The project had eleven partners from eight European countries. The clinical partners came from Czech Republic, Denmark, Estonia, Finland, Lithuania and the Netherlands. R-Bay is an online eMarketplace, a consultation portal, for buying and selling of imaging related telemedicine services.

In the R-Bay project 171 different radiology cases from Finland were reported in Estonia. Between Denmark and Estonia the corresponding number was 45 in this project. However, only knee X-ray images were reported. For second opinion 283 Czech radiology cases were randomly selected, anonymized and interpreted by the Dutch hospital.

In R-Bay we used a consultation portal (a radiology eMarketplace) to facilitate many-to-many connections between the teleradiology customers and providers. Many-to-many connections were achieved by using a central node through which several health care providers can securely get connected although with one integration only. The examinations were transferred from the local PACS to the intermediate teleradiology archive and reported using the viewing tool of the consultation portal. Streaming technology was used also in this project. Transfer of requests and final reports was similar to Baltic eHealth. The technical connection between the parties was established using secure VPN tunnels. Access to the patient data was permitted only for health care personnel who had been entitled by the health care institution.

2.2. Semantic interoperability

There were no institutions participating in the projects speaking the same language. For reporting three types of linguistic solutions were used. In primary reporting either the structured multilingual reporting tool (SRT) or the native language of the customer was used. All second opinions were written in English.

Structured multilingual reporting tool (SRT) created by radiologists participating in the Baltic eHealth project was used to deliver the report with a foreign language. The idea of SRT is to translate radiology exam findings automatically from one language to another. Today this tool supports four languages (Danish, English, Estonian and Lithuanian) and two anatomical regions (knee and hip). The radiologist uses a structured reporting template with his or her own language. In this template the possible findings are described. The radiologist creates the report using available templates and pulls down menus of multiple choices (Fig. 1). SRT uses semantic translation of findings rather than word for word translation. Selecting the sentence in one language generates automatically sentences in the three other. SRT contains more than 500 different sentences or phrases for one anatomic region. For uncovered findings there was an option to write free text which can be translated by an interpreter. SRT was used for translation of 195 knee X-ray reports from Estonian or Lithuanian language into Danish language. The rest of 454 reports were written in the cus-