OBSERVATION

NEW TECHNOLOGIES IN DIAGNOSING OCCUPATIONAL ASBESTOSIS

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The paper considers the possibilities of applying telemedicine, a relatively new branch combining medicine and telecommunications, in diagnosing occupational asbestosis. Nowadays, telemedicine has been extensively used in an ever-increasing number of areas such as dermatology, oncology, radiology, surgery, cardiology, and psychiatry. The paper gives an example of possible applications in Croatia. Telemedicine is expected to significantly reduce absenteeism and travel expenses incurred by various laboratory tests. Furthermore, the diagnostic procedure would be considerably quicker, thereby improving the overall health condition of the population living in the immediate vicinity of asbestos factories. Our research has been conducted in the southern Croatian town of Ploče with an asbestos plant, but possible application refers to places distant from major hospitals, such as rural areas and the islands.

Key words:
algorithm, chest radiography, computer system, diagnostic procedure, telemedicine

This paper is based on research conducted in Ploče and its surroundings. The town of Ploče lies at the mouth of the Neretva River, and is halfway between Dubrovnik and Split accommodating major hospital facilities. The town has a factory manufacturing asbestos textile, insulators, and other related materials (1). Although asbestos has increasingly been replaced by mineral (man-made mineral fibres) and organic (synthetic organic fibres) substitutes, its production has not ceased altogether.

Exposure to asbestos

People can be exposed to asbestos both professionally or environmentally. Those working in asbestos industry or using asbestos products at work such as firemen are occupationally exposed, whereas environmental exposure refers to people who live in

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the immediate vicinity of the plant (the so-called vicinal exposure), or people who are related to those employed in the industry (household contact or domicile exposure). Urban exposure refers to the ubiquity of the mineral and in some areas asbestos may be regarded as endemic. Environmental exposure is particularly harmful to those subjected to minimal, but lifelong exposure. The terrain and the prevailing winds in the Neretva valley pose a particular threat to the health of the population living in the direction of these winds (2).

Asbestosis of the lung and pleura is a reaction of the body to inhaled and accumulated asbestos fibres. The course of the disease tends to be progressive and is independent of prolonged exposure. If asbestosis is diagnosed at an early stage and the patient moves away from the contaminated area, the natural course of the disease may slow down or even stop altogether, depending on the quality of the patient's immune system. Abstracting the medicolegal issues, it should be emphasised that there is no diagnostic difference between occupational and environmental asbestosis. Whereas the occupationally exposed population undergoes regular and routine medical check-ups once in every two years, the rest of the population is not examined on a regular or organised basis, which renders an early diagnosis difficult, and sometimes even impossible. A connection between asbestosis and increased occurrence of malignant tumors such as throat cancer, lung cancer, and pleural and peritoneal mesotheliomas, has been established both in the occupationally exposed and in the general population living in an asbestos-contaminated area (3–5).

Telemedicine

People living in rural areas worldwide have been struggling to improve their health care services which often lack in sufficient specialist care, primary due to the fact that specialists tend to concentrate in more populated areas. Innovations in telecommunications technology made possible a number of medical treatments or diagnostic procedures regardless of the physical distance between the patient's physician and a specialist. Telemedicine is an employment of electronic information and telecommunications technologies in such cases when participants are apart from each other. Electronic information may consist of high-resolution images, sound, (live) video recordings, patient files, and so on. The transfer of relevant data may make use of various telecommunications technologies including the usual telephone lines, Integrated Services Digital Network (ISDN), Asynchronous Transfer Mode (ATM), Internet, Intranet, and satellites.

Telemedicine has been increasingly applied in a number of medical fields such as dermatology, oncology, and radiology. Today, the development trends may be outlined as follows (6–8):

- ❏ applying telemedicine in local surgeries in order to significantly reduce the cost and the time of patient's transportation;
- ❏ adapting rural surgeries and enabling them to transmit images and information for inspection and scrutiny by specialists in major hospitals;
- ❏ facilitating clinical research for physicians regardless of geographic distance;
- ❏ enhancing education and training of medical staff in rural areas.

Detecting a disease at an early stage may prolong or save the patient's life, which in itself is a valid justification for the use of new technologies and communica-

tion possibilities. Although telemedicine is rapidly growing and developing, its application in Croatia has only just started and the basic purpose of this paper is to point out the possibilities of its application. Furthermore, our intention is to discuss possibilities in developing a system for diagnosing occupational asbestosis and see in which locations its application is necessary and justified.

TECHNICAL REQUIREMENTS AND METHODS

Figure 1 gives an example of a telemedicine system consisting of personal computers (PCs) connected to the Internet. The other possibility is to have a central computer, connected to the outside world and linked with terminals which are, in their turn, connected to a local network (Local Area Network – LAN).

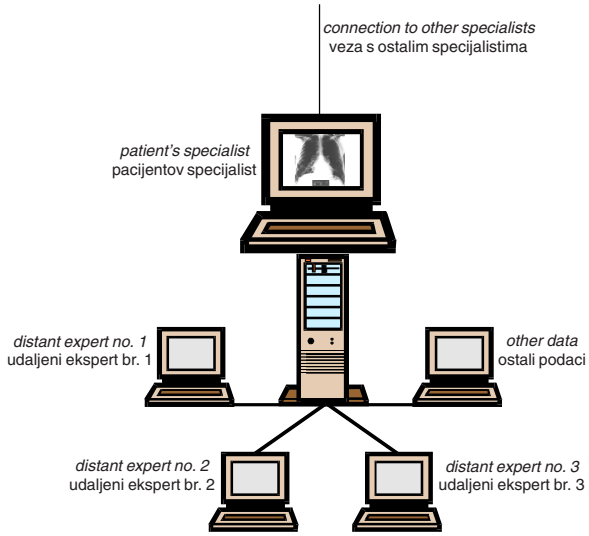

Figure 1 *A computer system linked with the world for telemedicine purposes*

For the town of Ploče, the indispensable minimum requirements would comprise a telephone line, a 14.4 KBPS modem or higher, PC 486 or better, a scanner, 8 MB of Random-access memory (RAM) or above, Microsoft® Windows-based Transmission Control Protocol/Internet Protocol (TCP/IP) applications, File Transfer Protocol (FTP), electronic mail, and user's account on the Internet.

The indispensable minimum requirements for distant experts would comprise a telephone line, a 14.4 KBPS modem or higher, PC 486 or better, 8 MB RAM or above, TCP/IP applications based on Microsoft® Windows operating system, FTP, appropriate applications to view images, electronic mail, and user's account on the Internet.

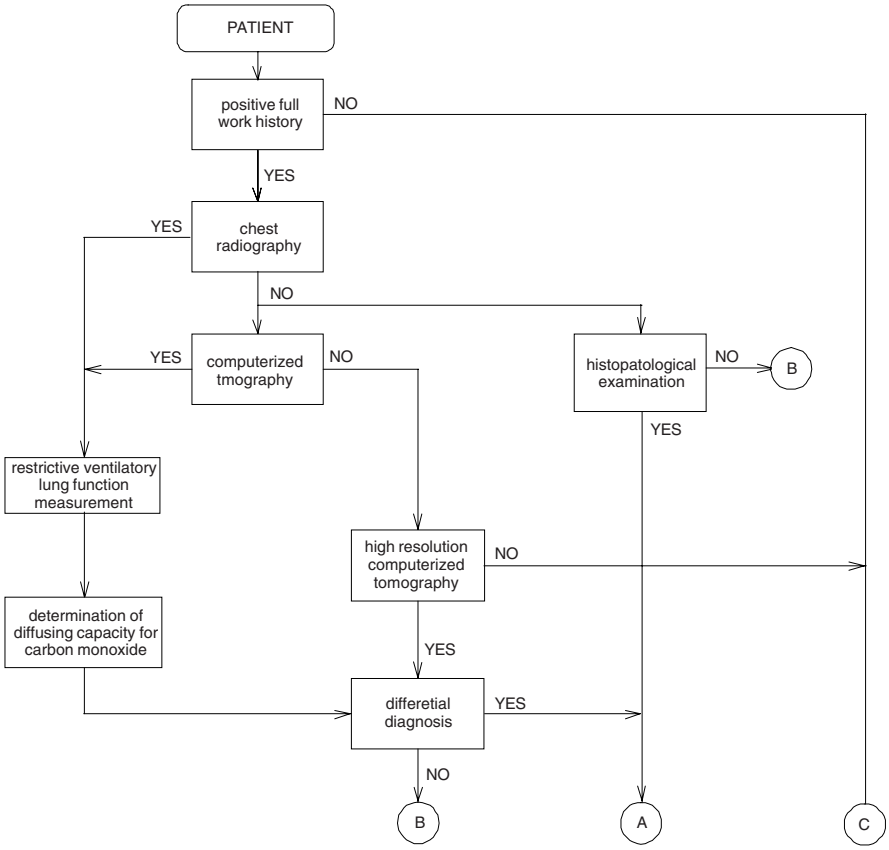

Figure 2 *Algorithm for diagnosing (occupational) asbestosis: A – proved asbestosis; B – asbestosis is not established, but exceptions are possible; C – asbestosis is excluded*

Possible applications of telemedicine in diagnosing asbestosis

Figure 2 shows the algorithm for diagnosing asbestosis. An algorithm is of paramount importance in developing a diagnostic system for occupational asbestosis (9). An algorithm-based diagnostic procedure makes it possible for a computer to process previous results and immediately suggest further series of tests.

The patient is the starting point of our algorithm. The aid of the computer is possible even at this stage, since only those patients who may have come into contact with asbestos are likely to develop asbestosis. The diagnostic procedure starts with a positive full work history. Should there be none, any possibility of occupational asbestosis can be ruled out. Chest radiography is the point of the algorithm where application of telemedicine is financially justified. The Ploče Community Health Centre is sufficiently equipped to provide chest radiography, but lacks in independent experts (at least three are required) skilled to interpret lung X-rays in accordance with the

internationally accepted International Labour Organisation (ILO) standards (10). Instead, all X-rays are taken to Split and Zagreb for expert reading. At this point, telemedicine would enable digital image transmission and significantly speed up the process. Moreover, the expertise would not be bound to the nearest provider but would allow the choice of the most skilled professionals. The expertise and the attached images could be sent via E-mail, which would further cut down the expenses of installing a telemedicine system (see technical requirements). The expert reply could include an ILO code comprising the quality, shadow, shape, size, as well as any abnormalities of the lung and the pleura. Further development would lead to the elaboration of an expert system by means of standardised ILO pictures, since abnormalities are extremely difficult to detect, which is why the opinions of three independent experts are required.

Computerised tomography and histopathological examination of the lung are an extremely important but also a time-consuming link in the diagnostic. The use of telemedicine would eliminate the need for a patient to fetch the results, which, so far, has entailed additional absence from work and travel expenses. Furthermore, the results could be forwarded for a second opinion anywhere in the world via Internet at no additional expense. It is particularly important to stress the possibility of creating a system for histopathological analysis. Namely, following biopsy, the photography of a histopathological sample could be forwarded to chosen experts who could establish the existence of a lung disease.

Differential diagnostic procedure aims at excluding the existence of other diseases. At that final diagnostic stage, it is important to have other expert opinions and telemedicine could plays an important role in quick and efficient completion of results.

DESCRIPTION OF THE TEST PROCEDURE

X-rays were scanned and sent via FTP to the author's E-mail. They were then downloaded to a home PC using a 14.4 KBPS modem and an ordinary telephone line. The medical expert analysed the images on the screen (as their quality on the screen is higher than when printed) and successfully distinguished the X-rays of a healthy patient from those of a sick one. Figures 3 and 4 show two of the scanned images.

There is an interesting possibility of computer application with regard to the procedure used in analysing the patients' X-rays and their comparison with ILO classification. Microsoft® Power Point, for instance, allows a physician to place a patient's X-ray centrally and compare it with classification images that can be set to appear automatically in a slide show.

Once the X-ray has been taken and scanned, it is saved on a computer in digital form and ready for further processing. It is possible to develop an expert system capable to detect the scope of change in the patient's lungs and pleura. It is also possible to conduct a double-blind diagnostic procedure in order to keep the patients' and the experts' identity unknown.

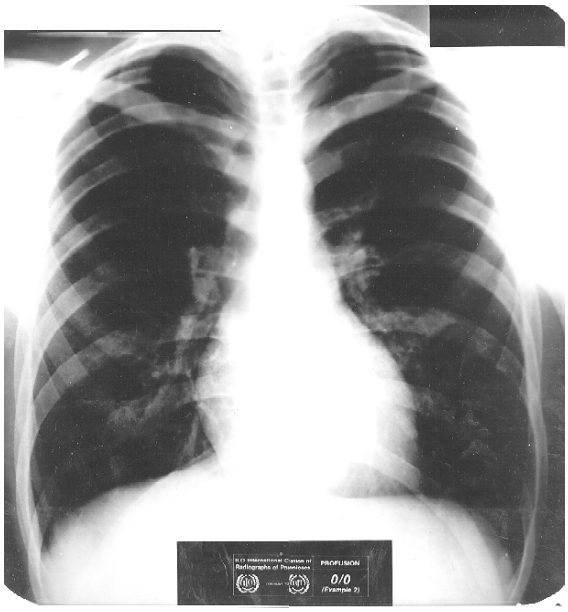

Figure 3 *International Labour Office classification, scanned image of ILO 0/0*

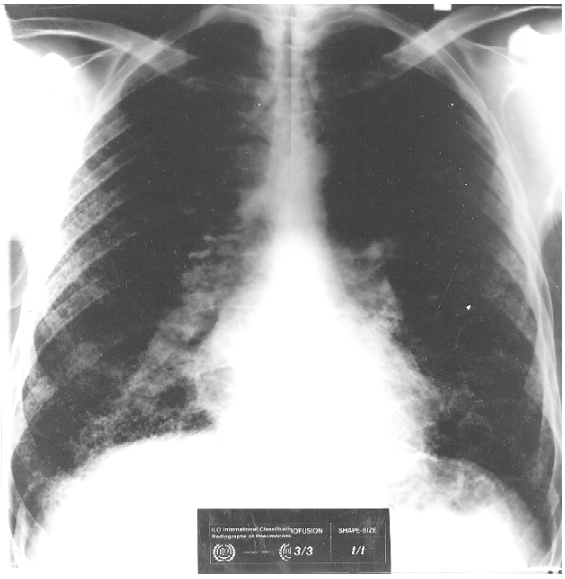

Figure 4 *International Labour Office classification, scanned image of ILO 3/3, t/t*

CONCLUDING REMARKS

Not only would telemedicine cut down the expenses and the loss of working hours, but would also increase safety and reliability and discourage possible misuse in cases of high indemnity claims which are of interest to companies insuring against occupational risks and diseases. The computer could automatically select an expert without anyone knowing it in advance. The use of telemedicine in Ploče does not require any additional investments, as the existing infrastructure suffices for the basic purpose. An expansion or further development of telemedicine could encompass other fields such as industrial medicine, internal medicine, paediatrics, and even surgery using real-time transmission of video images. Such improvements, however, require additional expenses.

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Sažetak

NOVE TEHNOLOŠKE MOGUĆNOSTI U DIJAGNOSTICIRANJU PROFESIONALNE AZBESTOZE

U članku se govori o mogućnostima primjene telemedicine, kao relativno nove grane medicine i telekomunikacija u dijagnostici profesionalne azbestoze. Danas se u svijetu telemedicina rabi u sve više područja, kao što su: dermatologija, onkologija, radiologija, kirurgija, kardiologija, psihijatrija, a ovo je samo primjer mogućnosti za razvoj tog područja u našoj državi. Očekuje se da bi primjenom telemedicine bili smanjeni izgubljeni radni sati, smanjeni putni troškovi potrebni za razne nalaze, ubrzan postupak dijagnosticiranja, što bi dovelo do poboljšanja zdravstvenog stanja stanovništva u blizini tvornice s azbestom. U članku je uzet primjer grada Ploča, ali se moguće primjene odnose na sva mjesta udaljena od većih bolničkih centara, ruralna područja i otoke.

Ključne riječi.
algoritam, dijagnostički postupci, profesionalna izloženost azbestu, računalni sustav, rentgenogram pluća, telemedicina

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