

## ABSTRACTS

### *DigiHealthDay - 2020* *Global Digital Health – Today, Tomorrow, and Beyond* *Deggendorf, Germany* *13 November 2020*

*J Int Soc Telemed eHealth 2020;8:eS1*

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DOI:10.29086/JISfTeH.8.eS1



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## Telemedicine and Remote Health Care

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## LOW-COST MOBILE SOLUTIONS FOR TELE-ULTRASOUND

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**Goal:** To investigate opportunities for tele-ultrasound imaging using smartphones and single-board computers.

**Materials and methods:** This study was focused on capturing ultrasound videos from video-output of ultrasound scanner using external video capture devices connected via USB. Raspberry Pi single-board computers and OS Android smartphones were used as platforms that hosted a tele-ultrasound server. Used software: VLC, Motion, USB Camera. Remote expert evaluation was carried out by comparison with the original image. The communication channels used 4G, WIFI and satellite Internet channel. VPN clients used were built-in Android VPN and PPTP for Raspberry Pi.

**Outcomes:** The video capture device built on the UTV007 chipset produces higher quality images compared to the AMT630A-based device. Optimal video resolution: 720x576 with 25 frames per second. VLC was considered to be the most suitable for the Raspberry Pi-based tele-ultrasound system due to low hardware requirements and wide bandwidth (0.64±0.17 Mbps). For OS Android smartphones, the tele-ultrasound system was set up using the USB Camera software, although it required wider network connection speed (5.2±0.3 Mbps). The maximum delay in video transmission was 1.2s for a satellite communication channel.

**Conclusion:** Implementation of the tele-ultrasound imaging system using mobile devices is possible. Due to limited bandwidth, single-boarded computers are generally considered to be the best host platform for a server. Provided there is a wide enough and stable Internet connection, the tele-ultrasound server can be hosted on a smartphone as well. It is recommended to use a VPN connection for additional security for the telemedicine system.

**Keywords:** tele-ultrasound, telemedicine, ultrasound, video capturing, Raspberry Pi, smartphone

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## TELEMEDICINE IN THE CONTEXT OF MEDICAL EDUCATION DURING ACTION AGAINST COVID-19

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**Purpose:** To evaluate the perception of medical students regarding the practice of telemedicine during program against COVID-19.

**Methodology:** Descriptive-exploratory study, with a sample composed of medical students from the 5th to 6th year of medical school, who participated in the "Home Testing Program for COVID-19" during the months of April to July 2020 in a Brazilian University.

**Results:** 114 students answered the questionnaire. 64.9% were from female sex and the average age was 25.58 years. About their experience during the practice of telemedicine, 40.4% of the students said they had difficulty in transmitting confidence during their attendance. 86.8% stated their anamnesis through telemedicine was impaired due to the impossibility of eye contact. 96.5% felt lack of data from the physical examination to assist the patient, however 73.7% said that physical separation did not harm non-verbal communication. 97.4% replied they believed their care in telemedicine was humanized.

On what barriers would prevent him from using telemedicine, 45.61% said they were afraid medicine would be trivialized, 44.73% said they would use it. Still on this issue, 39.47% said they would not feel safe, 23.68% replied that the lack of regulation would be a barrier, 8.77% did not believe in the effectiveness of this type of tool and 5.26% said that medical care should be exclusively in person. According to the students' report, difficulties in care included: "Not having eye contact ..."; "Really evaluating the patient's clinic ..."; "Know if the symptoms were really true."; "Perform the physical examination only with the patient's report"; "Fill the moments of silence, when they would be done with eye contact".

**Keywords:** COVID-19; digital medicine; telehealth; telemedicine; digital transformation; medical studies.

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### Privacy, Security, Trust, and Patient Engagement

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#### WHAT ARE THE APPROACHES TO MITIGATE PATIENT IDENTITY-RELATED CHALLENGES IN AN ATTEMPT TO ACHIEVE INTEROPERABILITY BETWEEN DIFFERENT HEALTHCARE ENTITIES?

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Patient identity management aims to process patient identity securely by managing, tracking, identifying and linking patients with their digital health information within and across disparate systems. The objectives were, to understand the current hospital infrastructure, designing and implementing the solutions and comparing other industry standards. The challenges this research work will address related to patient-identity are semantic interoperability across disparate systems, de-identification of patient demographic information to enable federated sharing, elimination of possible duplicates of patient records, cross-institutional identification of patients patient in a project (clinical trial), and availability of clinical data for research purpose. To mitigate these challenges pseudonymization service was implemented in MeDIC (Medical Data Integration centre, Uniklinik Köln). This pseudonymization service generates pseudonyms from patient demographic information, used as unique identifier across multiple systems and different healthcare organizations without disclosing the actual patient identity. This research also attempts to validate the operations of the Mainzliste (Software by TMF-BMBF) based on specific scenarios. The rationale for the defined scenarios are due to some common errors associated with patient identity. After extensive data analysis, it is evident that the pseudonymization service (Mainzliste) is able to generate pseudonym and perform de-duplication(record-linkage) in all possible scenarios. The maximum margin of error for CI 95% observed was  $\pm 2.93\%$ , which indicates the satisfactory accuracy level of Mainzliste. Some limitations with pseudonymization service were project-specific pseudonym, addition of identifiers to improve generation of pseudonyms for special scenarios, pre-defined data types in some of the fields, and scalability of record-linkage service which was not evaluated by this work.

**Keywords:** Patient identity, Privacy, Interoperability, Pseudonym, Record-linkage

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**DigiHealthDay – 2020****EHR, Health Information Systems**Back to [Contents](#)**APPLYING USER RESEARCH IN VERSION CHANGE OF A CLINIC MANAGEMENT SOFTWARE: PHYSIO PLUS TECH****Ram Prakash Suriyanarayanan, Georgi Chaltikyan**

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**Objectives:** The objectives of this study were to apply user research in the version change of Physio Plus Tech, a domain specific clinic management software, to analyse the impact of user research against the change resistance and to compare the usage behaviour towards the enhanced user interface with the conventional user interface of a health professional facing Health IT.

**Methods:** A mixed methods study was conducted in three phases during the version change life cycle on a representative sample of the product users with the help of usability guidelines review, standardized usability questionnaire, Health-ITUES, Heuristic evaluations from the NIST EUP (EHR Usability Protocol) and quantitative evaluation was done on the task and usage analytics. Other complementary methods like live user observation, instant chat and email issue reporting were also quantified.

**Results:** The study revealed that the new user interface enhanced with user research was accepted based on the user characteristics and frequency of usage. Change resistance was insignificant among the new users, but the long term users did show a considerable change resistance despite the enhanced user interface. It was also found that complementary methods of usability evaluation is an integral part of change implementation as they constituted a larger proportion of issue reporting and assist users than the standard usability evaluation and the demo videos. Usage behaviour towards the enhanced user interface has considerably improved.

**Conclusions:** Application of user research in the version change is a long systematic process and it had impact over the change resistance based on the user characteristics and degree of user acquaintance, and thus a correspondingly intensive systematic training program is recommended for long term users based on the relevant user types before the change implementation. User interface enhanced with user research is comparatively usable than a conventional user interface.

**Keywords:** User Research, Usability Evaluation, EHR Usability, Version Change, Clinic Management Software, Practice Management Software.

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Systems biomedicine as a new paradigm has grown into an independent section of interdisciplinary and transdisciplinary knowledge at the intersection of many disciplines. Its appearance is due to both the need to generalize the constantly growing biological knowledge and data on medical activity. It includes knowledge of interdisciplinary, multidisciplinary and transdisciplinary approaches for assessing modern scientific achievements, generating new ideas in solving research and practical problems. However, research in this direction is clearly insufficient. The aim of this work was to create a universal system for organizing and processing transdisciplinary knowledge in medicine. It is concluded that such a system should become the basis for organizing known knowledge, combining the possibility of being updated for the arrangement for existing needs and capable of being the basis for creating new industries and a sectoral conceptual dictionary.

Transdisciplinary research forms a special level of moral responsibility of specialists for the results and consequences of their professional activities within the framework of the objective obligation and compulsory elements of a single world. Taking into account the new direction at the level of training highly qualified personnel, the universal general cultural competencies of a specialist are changing. They should include the use of knowledge of interdisciplinary, multidisciplinary and transdisciplinary approaches to assess modern scientific achievements, generating new ideas when solving research and practical problems, including in interdisciplinary areas; the ability to design and carry out complex research, if necessary, based on a holistic (interdisciplinary) and transdisciplinary worldview. One of the directions of transdisciplinary research is the creation of a theory of hybrid reality, which implies a close relationship between technologies and people, both individuals and groups.

**Keywords:** Systems biomedicine, transdisciplinary knowledge in medicine, hybrid reality

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## INFORMATION TECHNOLOGY IN THE TRANSFORMATION OF MEDICAL EDUCATION

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Increased mobility of doctors and pharmacists is a characteristic feature of today. The European Commission Directive has facilitated mobility by providing for the international recognition of professional qualifications. At the same time, increased mobility of health workers can pose a potential threat to the quality of care. The main risk factors are the new working environment in a particular health care system, characterized by its own principles of quality of care, different patterns of morbidity, and different requirements of patients. New requirements are also imposed on teachers of the postgraduate education system. The problems of development of postgraduate medical education of teachers are considered. It is emphasized that there is no comprehensive system of training and advanced training of postgraduate medical education teachers today. The purpose of the study was to substantiate the scope of programmatic and purposeful efforts to ensure the traditional orientation of the development of teaching staff to improve postgraduate medical teaching based on the use of the ideology of a systematic approach. It is concluded that the training of teachers in the system of postgraduate medical education in the period of intensive reform of the industry is of extreme importance. A special training program is proposed within the framework of the systematic system of continuous pedagogical development (SCPD). The special indicator of personality development, which is a vector characteristic, is offered, and its coordinates are the digital characteristics of the level of competence, knowledge, skills and social activity.

**Keywords:** Systematic continuous pedagogical development (SBSP), competency approaches, mobile medicine, supervisory scales, distance learning, portfolio, system of teacher training in postgraduate medical education.

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## SYSTEMIC REPRESENTATION OF INFORMATION AND ENERGY PROCESSES IN THE BODY BASED ON A SHORT RECORDING OF HEART RATE VARIABILITY

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The universality of the laws of organization and flow of information and energy processes at the microlevel of matter allows one to consider living biological organisms as cybernetic systems as well. Electromagnetic phenomena of cardiac activity are the most studied and accessible in medical clinical practice. The heart is the organ that sets the rhythm for the wave oscillatory processes of the whole organism at the macro level. A complex vibration can be divided into its initial simple vibrations and a clinical assessment of their frequency and power can be made. This can give the doctor the opportunity to obtain objective individual detailed information about the contribution of regulation mechanisms to cardiac activity and the functional state of the patient's body as a whole. These data may have significant clinical significance for monitoring the effectiveness of treatment and prognosis in a "4P medicine model". Therefore, further study of the possibilities of using the method of spectral analysis of heart rate variability is relevant and promising for clinical medicine. Conclusions: 1). Performing an orthostatic test in functionally healthy respondents causes a functional mobilization of the cardiovascular system in the form of one of four types A, B, C, D. 2). Types of mobilization/adaptation to an orthostatic test have clear mathematical laws of spectral dynamics of HRV and characteristic graphic visualization of dynamics. 3). The concept of a dual-circuit cybernetic model of regulation of cardiac activity R.M. Baevsky is most suitable for the clinical interpretation of the results.

**Keywords:** Spectral analysis, heart rate variability, regulation mechanisms, cardiac activity

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## DIVERSITY OF ELECTRONIC INFORMATION SYSTEMS: "ECOIS" MONITORING SYSTEM

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Great diversity of electronic information systems used in human practice nowadays is a real characteristic of contemporary world. The purpose of our work was the development of new specialized information system for monitoring of changes in organisms due to the chemical pollution of environment in wide time ranges using modern information and computer technologies, on the base of novel electronic information systems with databases. During the work following methods were used: methods of comparative research of the samples of technical devices, imitation modelling, which was based on numerical results obtained in experiments with the recording of chemo sensitive transmembrane electrical currents in neurons in voltage clamp mode or patch-clamp, other methods. In result the original "EcoIS" system have been developed for monitoring in wide time ranges. "EcoIS" was supplemented with detector groups, databases, expert subsystem and interface. The system was able to distinguish between certain types of chemicals at the input; to display their identification data and, if necessary, reports about their harmfulness. For "EcoIS" system, some its elements the patents of Ukraine were obtained. The consequences of chemicals influence in few time intervals were possible to study: from the first moments of their influence on single organism cells – to months and years after this influence on whole organism. Some results of the work done will be demonstrated as well as conclusions about the functioning of constructed information system and its practical application will be suggested.

**Keywords:** information system, health protection, chemical substances, monitoring, indicators

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**HOW TO IMPROVE LARGE SCALE EMERGENCY MANAGEMENT BY INTRODUCING MODERN ICT**

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**Background:** Technology has presented man with lots of possibilities and is being applied in many facets of society, especially more rapidly now in the healthcare domain. Finland is one of the pioneer countries heavily investing in health ICT and eHealth. **Objectives:** This study was designed to examine existing literature on the impacts of health ICT and eHealth in Finland, and further discuss their role in tackling COVID-19.

**Method:** Literature search was carried out on PubMed, Google Scholar, and Science direct. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), retrieved studies were screened using defined inclusion and exclusion criteria, then subsequently perused to understand the thematic concepts being expressed by their authors before final selections were made.

**Results:** A total of 62 studies were identified as related publications, of which only eight met the exclusion and inclusion criteria. These were read in-depth for theme abstraction and reporting. All the authors showed that Finland remains one of the pioneer adopters of health ICT and eHealth in its healthcare system.

**Conclusion:** Over the years, Finland has developed strong digital health infrastructures like Kanta which serves as a data repository and health information exchange system for all patients in the system. Although not all the publications performed a thorough impact assessment, most revealed the impact of Kanta which provided a solid platform for numerous eHealth solutions making healthcare provision efficient, affordable, and personalized. These together with other health ICT, and Artificial Intelligent systems massively enhanced the management of COVID-19 in Finland.

**Keywords:** eHealth, health information and communication technology (Health ICT), Finland, electronic health record (EHR), COVID-19, telemedicine, health information exchange (HIE)

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**THE ESTONIAN NATIONAL HEALTH INFORMATION SYSTEM**

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**Background:** The Estonian eHealth system called the Estonian National Health Information System has been functioning since 2008. Some of the main factors that have contributed to its success are an IT receptive population, transparent governance, a mature IT ecosystem, proper access rights agreements, data standardization, interoperability, and data exchange rules. **Objective:** This study aimed to systematically review and summarize available academic publications on the eHealth infrastructure of Estonia and to discuss its impact both on the healthcare system in general, as well as in their fight against the COVID-19 pandemic.

**Method:** A systematic literature review based on qualitative inclusion and exclusion criteria was conducted to identify relevant publications for an analysis of the eHealth infrastructure of Estonia.

**Result:** Only a few academic publications can be found about Health ICT and eHealth in Estonia. Based on the different search terms about eHealth and Digital Health there were only 19 PubMed hits. Only 2 out of the 19 publications (10%) could be included in the detailed review. Out of these 2 studies, none comprised a full overview or description of the Health ICT or eHealth infrastructure.

**Conclusion:** The Estonian eHealth infrastructure is extensive, effective and has had numerous positive impacts on the health system in Estonia. More academic research into the detailed economic and health impact of the various elements of the eHealth system for the period they have been in place needs to be done, to aid countries in making decisions on parts of the system most suitable for adoption.

**Keywords:** electronic health records, health information systems, Estonia, blockchain, eHealth

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#### MEDICAL PLATFORM FOR CONTINUOUS HEALTH MONITORING AND PREVENTION OF DISEASE

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There are no high-quality solutions on the market that can fully solve the issues of primary screening and continuous monitoring of health condition. The entire market and most of the products are focused on situational diagnosis or symptomatic treatment. MoniHeal is an online service for continuous monitoring using software analysis of personal health indicators, as well as immediate correction of any health problems to effectively prevent diseases in the future. Platform's mission and purpose - to become a reliable assistant in maintaining health. The functionality of the platform is aimed to be useful for medical expert and family doctors. Online access to doctors of different specializations, the ability to book their services in order to receive treatment regimens, prescriptions and diagnose diseases. There is a marketplace of family doctors for users to choose and sign online a declaration. An opportunity to give a family doctor access to a personal medical archive. The doctor has the opportunity to organize the process of treating of his patients in the remote mode. As well as effectively manage working hours provide online services and get online access to new patients. The family doctor (personal medical manager) remotely monitors the dynamics of the patient's health condition. Has access to the patient's medical archive and, if necessary, has ability to direct patients to specialists of the second and third level of medical care. Partner clinics can post information about their services and innovative achievements, as well as to inform patients about promotions and special offers.

**Keywords:** medical platform, personal medical archive, online service for continuous monitoring

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## TECHNOLOGIES OF ARTIFICIAL INTELLIGENCE AND SMART MICROELECTRONICS IN MOBILE TELEMEDICINE

Ozar Mintser, Volodymyr Romanov, Igor Galelyuka, Oleksandr Voronenko

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The integrated digitalization of medicine, the use of the Internet of Intelligent Things, smart microelectronics and the networks of medical wireless sensors offers ample opportunities to remotely support the appropriate quality of life of chronically ill patients, the elderly, and athletes and professionals with heavy physical or mental workloads.

Based on this, at the present stage of development of artificial intelligence technologies and smart wearable microelectronics, the following basic directions of digital mobile telemedicine development can be identified:

- 1) Development and creation of wearable medical monitors, which are built on the basis of smart sensors for real-time measurement of basic medical parameters and integrated into a wireless sensor network.
- 2) Development and creation of wearable means for reading and primary processing of measured medical parameters, combined with smart sensors.
- 3) Development and creation of wearable means for transmitting parameters, which are measured by a mobile medical monitor and which characterize in real time the human condition, to remote decision-making centres.
- 4) Development and creation of remotely controlled wearable injectors for the introduction of the necessary drugs that support human life in case of critical condition of the patient.

The current state and prospects for the development of these tools in mobile telemedicine are discussed in the report.

**Keywords:** Mobile Health, Wearable Technology, Wireless Technology, Information Networks, Wearable Devices, Analogue-Digital Conversion

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## SMART MEDICAL COMMUNICATOR FOR ESTIMATING QUALITY OF LIFE

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Assessing the adequate level of health of patients and the effectiveness of treatment methods require modern clinical studies of "quality of life" (QOL) through the use of various standardized questionnaires, both general purpose and designed for individual nosologies. The assessment of QOL, which is performed by the patient using questionnaires, together with the traditional medical opinion of the doctor, gives a complete and objective description of the patient's condition.

The goal of the work is to develop smart communicator with application software to automate quality of the life assessment based on the standardized MOS SF-36 questionnaire on a mobile tablet computer-base using the results as information support for making objective medical decisions.

The method of estimating the quality of life according to the MOS SF-36 questionnaire is based on the instruction for calculating the indicators of quality of life, for which the application software has been developed. This application software

estimates quality of life indicators on 8 scales.

The analysis of the subject area of common standardized questionnaires to assess the quality of life of patients revealed the optimal for automation - The Medical Outcomes Study Short Form (MOS SF-36) - a short form of non-specific questionnaire for QOL. The stage of development of software for automation of quality of life assessment based on the standardized questionnaire MOS SF-36 for mobile tablet computer, the results of which can serve as information support for making informed medical decisions, has been completed.

**Keywords:** Information Technology, Computer Applications Software, Quality of Life, Questionnaires

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## DigiHealthDay – 2020

### Digital Health Education

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#### IMPLEMENTING HEALTH INFORMATION TECHNOLOGIES IN UNDERGRADUATE MEDICAL CURRICULA AS A TOOL IN THE TRANSFORMATION OF HEALTHCARE SERVICES AND QUALITY IMPROVEMENT

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European Medical Business Institute (EMBI) at EurAKA University, Switzerland

**Background:** Medical graduates may not be adequately prepared for the modern challenges in Health Information Technologies implementation as medical education has barely added competencies matching the changing pace of today's technological world. To promote the teaching of these competencies at the highest level, the faculty must be proficient in HIT and be able to teach the expected level of competence of their students and residents.

**Methods:** This is a follow up study that was based on recollecting online curricula offered from the top medical universities according to QS World Ranking in the Americas and compared with DACH Countries (Germany, Switzerland, Austria). These were examined for the presence of HIT as an explicit component of the curriculum. The initial search identified courses meeting this definition. The data collected was consequently submitted to qualitative analysis.

**Results:** The incorporation of Health Informatics subjects in some universities is high. As Developed countries set the trends, other countries could follow and include HIT in their medical school curricula.

**Discussion/Conclusion:** The gain of new Health Informatic Technology skills makes the medical pre-graduate more competitive in the changing health market. With proper training and a dynamic pluralistic behaviour, which progressively develops structure through time and aims at partial or complete modification of the social order, the students will demand those competencies in order to choose their medical school, accomplishing the full digitalization from healthcare and trained professionals in the field, filling the big IT gap that exists right now.

**Keywords:** Health information technologies, undergraduate medical education, delivery of healthcare, healthcare quality assessment, Health Services Needs and Demand

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**DigiHealthDay – 2020****Data standards and Interoperability**Back to [Contents](#)**DESIGN OF A HEALTHCARE DATA MODEL USING HDF5 TECHNOLOGY WITH RESPECT TO INTEROPERABILITY, PORTABILITY AND PERFORMANCE COMPARED TO RDBMS****Jonathan Okereke<sup>1</sup>, Georgi Chaltikyan<sup>2</sup>**<sup>1</sup> Uniklinik Köln, Germany<sup>2</sup> Deggendorf Institute of Technology, European Campus Rottal-Inn (DIT-ECRI), Germany;

This research focuses on the use of HDF5 technology in the implementation of Radiology Information System. It compares HDF5 with RDBMS in respect to interoperability, data portability and specific performance metrics like read-efficiency, write-efficiency and response time in retrieving multi-dimensional data. Experiments conducted in this research supports the hypothesis of using HDF5 in handling large datasets, storing and processing DICOM images without restriction on size or number of dimensions. It also showed the ability of HDF5 to handle heterogeneous data without prior knowledge of the data type unlike RDBMS that requires the knowledge of the data type. The results from the experiments in this study indicates why some researchers in the scientific community have proposed to use HDF5 as the underlying data model for several scientific explorations (like NASA Earth Observing System, Crown of the continent projects etc.) and also in the development of software applications like MATLAB. Data used in this study was anonymized and extracted from a PACS using an ETL pipeline. In an attempt to adequately compare both models, the schemas were designed in such a way that enables each model to perform optimally. HDF5, however, was reported to perform better compared to RDBMS for the metrics measured.

**Keywords:** Interoperability, DICOM, big data, HDF5, radiology information system*Author contact details:*Jonathan Okereke; [jonathan.okereke@uk-koeln.de](mailto:jonathan.okereke@uk-koeln.de); ORCID 0000-0001-7728-5401Georgi Chaltikyan, [georgi.chaltikyan@th-deg.de](mailto:georgi.chaltikyan@th-deg.de); ORCID 0000-0003-0743-2036Back to [Contents](#)