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| **Abstract:** | This document provides updated information on 5 papers from the Kaleidoscope 2019 academic conference (K-2019), "ICT for Health: Networks, standards and innovation", that are published in the Conference Proceedings, and which may be relevant to the work of the ITU-T Focus Group on Artificial Intelligence for Health (FG-AI4H). The purpose of this document is to invite the FG to take into consideration these papers in its activities. The Annex provides information on K 2019. An evaluation of all Kaleidoscope 2019 papers with respect to relevance in ITU activities will be presented at TSAG, 10-14 February 2020. FG-AI4H delegates are invited to note that the 12th edition of the ITU Kaleidoscope academic conferences, “Industry-driven digital transformation” will be held in Ha Noi, Viet Nam (7-9 September 2020) in conjunction with ITU Digital World. Kaleidoscope 2020 will analyse industry’s introduction of new technologies capitalizing on connectivity and intelligence. It is expected to explore innovations in fields such as robotics, cyber-physical systems, digital twins, virtual simulation, augmented reality, edge computing, artificial intelligence and blockchain – innovations all contributing to the digital transformation of industrial processes. Submissions are invited until 6 April 2020. Further information is available on our conference website. |

**Papers which may be relevant to the work of the FG-AI4H:**

* **Session 2 – Medical ICT**

**S2.2** *Development of hearing technology with personalized safe listening features* [[**Presentation**](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S2.2_Shayan_Gupta.pdf)]
[Shayan Gupta](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/Shayan-Gupta.aspx), Carnegie Mellon University and Audition Technology, LLC, United States; Xuan Xu, Hongfu Liu, Jacqueline Zhang; Joshua N. Bas and Shawn K. Kelly, Carnegie Mellon University, United States

This keynote summary is available from page 39 of the [Conference Proceedings](https://www.itu.int/pub/T-PROC-KALEI-2019).

**Abstract**

*Noise induced hearing loss (NIHL) is a growing public health concern in the US and globally due to the emergence of lifestyle preferences and environmental exposures to sound levels exceeding safe listening limits for extended periods of time. Issuance of the ITU guidelines for safe listening devices/systems (ITU-T H.870) leading to the 2019 WHO-ITU standard, along with existing US federal and military standards, provide a framework for developing an accessible tool for promoting safe listening. Our proposed Hearing Health app, is being developed for an aggregated assessment of a user's daily sound exposure, through the audio system and the environment (occupation and beyond) by integrating WHO-ITU and US safe listening standards, providing real-time alerts, user-centric recommendations and education that can be integrated into user lifestyles, representing a wide demographic including young adult, adult, civilian and military populations. The overall goal of the app will be to increase NIHL awareness and facilitate improvement of user's listening behaviors.*

* **Session 4** – **Part I – Digital health strategies**

**S4.1 Invited paper:** *Towards international standards for the evaluation of artificial intelligence for health* [[**Presentation**](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S4.1_Markus_Wenzel.pdf)]
[Markus A. Wenzel](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/Markus-Wenzel.aspx)**,** Fraunhofer Heinrich Hertz Institute, Germany; and Thomas Wiegand, Fraunhofer Heinrich Hertz Institute and Technische Universität Berlin, Germany

Paper is available from page 67 of the [Conference Proceedings](https://www.itu.int/pub/T-PROC-KALEI-2019).

**Abstract**

*Healthcare can benefit considerably from advanced information processing technologies, in particular from machine learning (ML) and artificial intelligence (AI). However, the health domain only hesitantly adopts these powerful but complex innovations so far, because any technical fault can affect people’s health, privacy, and consequently their entire lives. In this paper, we substantiate that international standards are required for thoroughly validating AI solutions for health, by benchmarking their performance. These standards might ultimately create well-founded trust in those AI solutions that have provided conclusive evidence to be accurate, effective and reliable. We give reasons that standardized benchmarking of AI solutions for health is a necessary complement of established assessment procedures. In particular, we demonstrate that it is beneficial to tackle this topic on a global scale and summarize the achievements of the first year of the ITU/WHO focus group on “AI for Health” that has tasked itself to work towards creating these evaluation standards.*

* **Session 5 – Smart technologies for caregivers**

**S5.1***Elderly health monitoring system with fall detection using multi-feature based person tracking* [[**Presentation**](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S5.1_Dhananjay%20Kumar.pdf)]
[Dhananjay Kumar](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/Dhananjay-Kumar.aspx), Aswin Kumar Ravikumar and **[Vivekanandan Dharmalingham](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/Vivekanandan-Dharmalingam.aspx),** Anna University, India; and Ved P. Kafle, National Institute of Information and Communications Technology, Japan

Paper is available from page 105 of the [Conference Proceedings](https://www.itu.int/pub/T-PROC-KALEI-2019).

**Abstract**

*The need for personalized surveillance systems for elderly health care has risen drastically. However, recent methods involving the usage of wearable devices for activity monitoring offer limited solutions. To address this issue, we have proposed a system that incorporates a vision-based deep learning solution for elderly surveillance. This system primarily consists of a novel multi-feature-based person tracker (MFPT), supported by an efficient vision-based person fall detector (VPFD). The MFPT encompasses a combination of appearance and motion similarity in order to perform effective target association for object tracking. The similarity computations are carried out through Siamese convolutional neural networks (CNNs) and long-short term memory (LSTM). The VPFD employs histogram-of-oriented-gradients (HoGs) for feature extraction, followed by the LSTM network for fall classification. The cloud-based storage and retrieval of objects is employed allowing the two models to work in a distributed manner. The proposed system meets the objectives of ITU Focus Group on AI for Health (FG-AI4H) under the category, "falls among the elderly". The system also complies with ITU-T F.743.1 standard, and it has been evaluated over benchmarked object tracking and fall detection datasets. The evaluation results show that our system achieves the tracking precision of 94.67% and the accuracy of 98.01% in fall detection, making it practical for health care system use. The HoG feature-based LSTM model is a promising item to be standardized in ITU for fall detection in elderly healthcare management under the requirements and service description provided by ITUT F.743.1.*

**S5.2** *A healthcare cost calculator for older patients over the first year after renal transplantation* [[**Presentation**](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S5.2_Rui_Fu.pdf)]
[Rui Fu](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/Rui-Fu.aspx), Nicholas Mitsakakis and Peter C. Coyte, University of Toronto, Canada

Paper is available from page 115 of the [Conference Proceedings](https://www.itu.int/pub/T-PROC-KALEI-2019).

**Abstract**

*Forecasting tools that accurately predict post-transplantation healthcare use of older end-stage renal disease (ESRD) patients are needed at the time of transplantation in order to ensure smooth care delivery in the post-transplant period. We addressed this need by developing a machinelearning-based calculator that predicts the cost of healthcare for older recipients of a deceaseddonor kidney over the first year following transplantation. Regression tree and regularized linear regression methods, including ridge regression, lasso regression and elastic net regression were explored on all cases of deceased-donor renal transplants performed for patients aged over 60 in Ontario, Canada between March 31, 2002 and April 31, 2013 (N=1328), The optimal model (lasso) identified age, membership of one of 14 regionalized Local Health Integration Networks, blood type, sensitization, having diabetes as the primary case of ESRD, total healthcare costs in the 12-month pre-workup period and the 6-month workup period to be inputs to the cost calculator. This cost calculator, in conjunction with clinical outcome information, will aid health system planning and performance to ensure better management of recipients of scarce kidneys.*

**Session 6** – Data and artificial intelligence era

**S6.1** **Invited paper:** *Preparing for the AI era under the digital health framework* [[**Presentation**](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S6.1_Shan_Xu.pdf)]
[Shan Xu](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/Shan-Xu.aspx), Chunxia Hu and Dong Min, China Academy of Information and Communication Technology (CAICT), China

Paper is available from page 135 of the [Conference Proceedings](https://www.itu.int/pub/T-PROC-KALEI-2019).

**Abstract**

*Information and communication technology (ICT) for health has shown great potential to improve healthcare efficiency, especially artificial intelligence (AI). To better understand the influence of ICT technology on health, a framework of the digital health industry has been proposed in this paper. Factors from the health industry and the ICT part are extracted to study the interaction between two groups of component factors. Health factors include service and management; and ICT factors include sensors, networks, data resources, platforms, applications and solutions. The interaction between ICT and health can be traced through the development history, from the stage of institutional informationization to regional informationization, and finally to service intelligentization. Following such a developmental roadmap, AI was chosen as one of the most powerful technologies to study the penetration effect and key development trends from the perspectives of data, computing power and algorithms. The health industry will be much improved or redefined in the coming AI era. To better understand the strengths, weaknesses and limitations of AI for health, exogenous factors are discussed at the end of the paper; preparations on collaboration mechanism; standardization and regulation have been proposed for the sustainable development of digital health in the AI era.*

**Annex:**

* **Information on ITU Kaleidoscope 2019**

**ANNEX**

*ITU Kaleidoscope 2019*

***ICT for Health: Networks, standards and innovation***

The 11th ITU Kaleidoscope academic conference
4-6 December 2019, Atlanta, Georgia, United States

***Kaleidoscope 2019: ICT for Health: Networks, standards and innovation* future was the eleventh in a series of peer-reviewed academic conferences organized by ITU to bring together a wide range of views from universities, industry and research institutions. The aim of the Kaleidoscope conferences is to identify emerging developments in information and communication technologies (ICTs) and, in particular, areas in need of international standards to aid the healthy development of the Information Society.**

The World Health Organization warns that at least half of the world’s population is still not fully covered by essential health services. In countries with sufficient coverage, caring for an ageing population requires significant expenditure from governments, as well as public and for-profit entities. Moreover, emergency response teams working in distress and disaster situations depend on interoperable and survivable networks and systems to effectively and efficiently rescue individuals and communities at risk.

Digital health is part of the "Fourth Industrial Revolution", where innovative ICT applications are mobilized to revolutionize the health sector – from manufacturing, to research and discovery, and health delivery. It harnesses new applications in ICTs to help tackle the technical and socio-economic challenges we face around health. The use of 5G, machine-to-machine (M2M) communications, cloud computing, the Internet of Things (IOT), etc. will lead the way to new frontiers in health services and towards the goal of universal, quality health coverage. Digital health will place rigorous requirements on communication networks including stricter requirements on service quality, tighter legal protections, and a more active role on the part of public authorities.

Accepted and presented papers are published in the Conference Proceedings and have been submitted for inclusion in IEEE Xplore Digital Library. The best papers will be also evaluated for potential publication in the IEEE Communications Standards Magazine. In addition, extended versions of selected papers will be considered for publication in the [International Journal of Technology Marketing](http://www.inderscience.com/jhome.php?jcode=IJTMKT), the [International Journal of Standardization Research](http://www.igi-global.com/journal/international-journal-standardization-research-ijsr/145878), or the [Journal of ICT Standardization](http://www.riverpublishers.com/journal.php?j=JICTS/2/2/jef). Pre-selected papers were evaluated for potential publication in [The Lancet Digital Health](https://www.thelancet.com/journals/landig/home).

**Audience:** Kaleidoscope 2019 targeted specialists in the fields of ICT, digital health and socio-economic development, including researchers, academics, students, engineers, computer scientists, policymakers, regulators, innovators, futurists, clinicians and health practitioners.

**Awards:** A prize fund totalling CHF 6 000.- was shared among the authors of the three best papers, as judged by the Steering and Technical Programme Committees. In addition, young authors of up to 30 years of age presenting accepted papers received Young Author Recognition certificates.

* **FIRST best paper**: "[Thought-based authenticated key exchange](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S7.1_Phillip_Griffin.pdf)" by Phillip H. Griffin, Griffin Information Security, United States.
* **SECOND best paper**: "[Redesigning a basic laboratory information system for the global south](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S4.2_Jung_Wook_Park.pdf)" by Jung Wook Park, Aditi Shah, Rosa I. Arriaga and Santosh Vempala, Georgia Institute of Technology, United States.
* **THIRD best paper**: "[Elderly health monitoring system with fall detection using multi-feature based person tracking](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Documents/Presentations/S5.1_Dhananjay%20Kumar.pdf)" by Dhananjay Kumar, Aswin Kumar Ravikumar and Vivekanandan Dharmalingham, Anna University, India; and Ved P. Kafle, National Institute of Information and Communications Technology, Japan.

For **additional information**, please visit the conference [website](https://www.itu.int/en/ITU-T/academia/kaleidoscope/2019/Pages/default.aspx).

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