

## Preface to Special Issue “Medical Imaging Technologies”

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### 1. Introduction

The global spread of COVID-19 has not only had a direct impact on people’s lives and health, it has also brought about major changes in behavior, thinking, and lifestyle. COVID-19 has highlighted issues in clinical practice such as the increasing burden on healthcare professionals and regional disparities in healthcare, but also led to developments in artificial intelligence (AI) and digital and communication technologies that have accelerated digital transformation (DX). Science and technology are now not only used as a problem-solving tool but spawning new trends in personal and social life. Shimadzu’s corporate philosophy is to “Contribute to Society through Science and Technology,” and since its founding, Shimadzu has pursued research and development with the goal of meeting a range of needs in society. Following COVID-19, Shimadzu is also firmly committed to improving ties with medical institutions and commercial partners to accelerate the social and commercial adoption of new technologies aimed at improving healthcare.

After living through this pandemic, people throughout the world have become more concerned about their health. Extending a healthy lifespan through improved quality of life (QOL) is now a primary area of interest. This has created a need for disease prevention, health promotion, and technologies for early diagnosis, along with the expectation that improved techniques offering higher rates of success and shorter recovery times will be developed for acute medical care. This special issue of Shimadzu Review reports on the achievements of Shimadzu’s recent research and development in the field of medical imaging equipment.

Many developed countries are now entering an era of declining birthrates and an aging population and seeing ongoing reforms in the working practices of healthcare professionals. With this backdrop, the management of worker shortfalls, curtailing the ballooning cost of healthcare, and improving medical safety are now becoming major issues. This special issue also reports on

Shimadzu’s efforts at reducing demands on labor and increasing efficiency in clinical settings and at improving medical safety.

### 2. Diagnostic Imaging Systems: Expanding Diagnostic Performance and Improving Ease-of-Use

- Development of the RADspeed Pro style edition GLIDE Class General Radiography System
- Development of the FLUOROsPEED X1 edition Patient-Side R/F System
- Clinical Evaluation of BresTome TOF-PET System

General radiography systems perform important examinations that are fundamental to diagnostic imaging. These systems examine many different areas of the body including the chest, abdomen, and extremities, and perform many examinations every day. For this reason, operators spend much of their time repositioning the X-ray tube of these systems for each examination. Shimadzu has developed systems with power-assist technology for less demanding and smoother equipment operation and an improved examination environment.

In fluoroscopy/radiography, Shimadzu has developed a patient-side R/F system that allows direct manipulation of the imaging system next to the patient. Patient-side R/F systems are particularly popular in the U.S. and the newly developed system supports a range of examinations such as bariatric evaluations of obese patients, swallowing examinations, and examinations of pediatric and geriatric patients, in order to meet the needs in the U.S. market. This special issue describes notable features and technologies of this system such as a flat panel detector (FPD), power-assist control, a height-adjustable table, and an increased load-bearing capacity.

In positron emission tomography (PET), this special issue includes a clinical evaluation of a TOF-PET system developed specifically for imaging the breast and head. The evaluation shows the TOF-PET system offers high-

resolution visualizations of pharmaceutical agents in the cerebral area that are beyond the scope of conventional whole-body PET systems, suggesting that this TOF-PET system could help improve diagnostic accuracy for brain disorders such as dementia.

### 3. Treatment Support Systems: Enhanced Features for Minimally-Invasive Interventions

- Development of Trinias (Opera) Series Digital Angiography Systems
- Efforts to Improve UX (User Experience) in Trinias (Opera) Development - Realizing Stress-Free Operations and Workflows -
- Development of the Dose-eye Live Real-Time Dose Monitoring Software for Digital Angiography System
- Development of Application Platform and Subscription Service, SCORE Link
- Development of the Surgical Mobile C-arm Imaging System OPESCOPE ACTENO FD type

Interventional radiography (IVR) offers a lower risk of complications and quicker recovery times than surgical techniques, and with considerable advances in therapeutic devices and new procedures in this field, IVR applications are expanding beyond cardiac vessels to include the lower extremities and cerebral vessels. However, these IVR procedures are increasingly complex and time-consuming, which is causing the patient and operator more stress and exposing the patient and operator to higher doses of radiation. To resolve these issues and accelerate the adoption of IVR, Shimadzu has developed a completely new application platform and angiography system that is future-proofed against changes in IVR procedures. This special issue summarizes four aspects of Shimadzu's accomplishments in this area. (1) The design concepts and features of new systems, (2) UX improvements for reduced operator stress, (3) dose monitoring for reduced patient doses, and (4) an application platform that offers ongoing added value.

In surgical radiography, Shimadzu has developed a surgical radiography system that retains the ease-of-operation of the C-arm that has been a feature of past systems while moving to an FPD. Combined with dynamic image processing technology, this surgical radiography system produces high-quality fluoroscopy images at low doses. This feature, along with superior ease-of-operation, offers a usability-oriented operating environment.

### 4. Software Applications: AI Integration and Growing Medical DX

- Improving the Efficiency of R/F System Applications by Deep Learning
- Development of the Smart DSI Retained Object Confirmation Support Software
- Development of Smart QM Vertebral Body Measurement Software
- Development of SimCLINIC T4 Cloud Cloud-Based Electronic Medical Record System

The emergence of AI has brought rapid advances in image processing technology. Shimadzu has actively pursued the development and introduction of AI technology in various fields, including to increase image quality, improve diagnostic performance, improve examination workflows, and ensure medical safety.

This special edition describes a number of different applications that use AI technology.

- 1) AI for improved workflow efficiency: AI was used to process parameter settings for the tomosynthesis application and bone density measurement application of an R/F system. The AI technology helps to execute manual tasks that previously required an experienced physician, thereby standardizing these manual tasks and improving workflow efficiency.
- 2) AI for medical safety: Although postoperative X-ray images are used to check for surgical items retained in the patient after surgery, retained items are still missed and there continue to be reports of medical accidents involving retained items. Shimadzu has developed a solution that uses AI-based image processing to assist this check by highlighting potential retained items in postoperative X-ray images.
- 3) Proposing new evaluation methods: The early diagnosis of vertebral body fractures is important for preventing the progression of osteoporosis and associated fragility fractures. The most effective method of identifying vertebral body fractures is quantitative measurement (QM), which identifies vertebral fractures quantitatively based on lateral radiographic images of the thoracic and lumbar vertebrae. However, QM requires complex vertebral measurements and is time-consuming. Shimadzu has developed an application that uses AI to assist these vertebral measurements and facilitate the rapid assessment of vertebral body fractures. This application is expected to help the early treatment of osteoporosis.

Medical DX is also increasing, with the widespread adoption of electronic medical records (EMR) systems that are now considered an essential tool for many medical facilities. This special issue reports on the development of a cloud-based electronic medical record system that enhances integration between in-facility diagnostic imaging systems and electronic medical records an area in which Shimadzu is proficient and facilitates data utilization for efficient clinical operations.

### 5. Conclusions

While the pursuit of health is an ever-present concern, the coming era of declining birthrates and aging populations is expected to bring new challenges. Shimadzu is committed to further expanding and evolving the technology it has developed over many years as a medical device manufacturer and recognizes the power of science and technology to meet the varied needs of medicine and society.