**FOR IMMEDIATE RELEASE**

# Hokkaido University Hospital Begins Treatments of Extraordinary Precision as the World's First Facility equipped with both Real-Time image Gated and Spot Scanning Proton Beam Therapy

Clinical Treatments take advantage of both
Gantry Mounted Cone Beam CT and Intensity Modulated Proton Therapy

**Tokyo, Japan, May 20, 2016** -- Hokkaido University and Hitachi, Ltd. (TSE:6501, "Hitachi") have jointly developed an advanced technique to treat moving targets with proton beam therapy. This project was awarded a grant in 2010 under the Funding Program for World-Leading Innovative R&D on Science and Technology (the "FIRST Program"), a national project sponsored by the Japanese government. This new technique is now being clinically used with two additional capabilities – Cone Beam CT ("CBCT") and Intensity Modulated Proton Therapy ("IMPT").

Proton beam therapy (PBT) is an advanced type of cancer radiotherapy. Protons, the atomic nuclei of hydrogen, are accelerated to high speed and their energy is concentrated onto tumors. The superb characteristics of proton beams allow patients to maintain their normal lifestyles during treatment as it is painless and impact to the body's normal functions are minimized. PBT has thus attracted attention as a cutting-edge therapy for treating cancer whilst maintaining patients' quality of life ("QOL"). As these characteristics enable precise dose concentration, PBT can be easily applied to stationary targets such as brain tumors. Treatment however, of tumors in the torso such as those in the lung or liver which move due to respiration, require special care - and thus the combination of PBT with real-time tracking to target moving tumors has been highly anticipated.
Hokkaido University Hospital began treating patients with Spot Scanning proton beam therapy in March of 2014 and by December of that year had begun treating patients with Real-Time image Gated Proton Beam Therapy ("RGPT"). Since then, RGPT has been used in approximately 40% of treatments involving the liver and prostate and 10% of those involving the lung and pancreas. Over 80% of all treatments at the hospital now incorporate RGPT.

1. Gantry Mounted CBCT

To further improve the accuracy of PBT, there is a constant need for improved imaging of the internal structure of the tumor region. When information on the location of bone is

taken from traditional orthogonal x-rays and the motion of tumors is captured by RGPT and then combined with the ability to identify healthy tissue surrounding a tumor, particularly the location and shape of soft tissue, it allows for a greater therapeutic dose to be directed at the tumor while significantly reducing the risk of irradiating healthy tissue. As a result, the ability to obtain this information immediately prior to treatment is increasingly being recognized as critical.

The rotating gantry mounted CBCT system, jointly developed by Hokkaido University and Hitachi, provides three-dimensional anatomical images of patients, at isocenter immediately prior to being treated, dramatically increasing the precision of the treatments. The CBCT system is also capable of highly accurate positioning even without the use of RGPT. After being approved for marketing under Japan's Pharmaceutical Affairs Law in March of 2015, the system was clinically put to use in October of the same year. Since then, 20 patients have been treated with the CBCT-equipped system and more patients are expected to benefit as clinical treatments continue.

Hokkaido University Hospital and Hitachi will continue to work together on a project titled Development of Medical Devices and Systems for Advanced Medical Services funded by the Japan Agency for Medical Research and Development (AMED) to further advance RGPT.

2. Intensity Modulated Proton Therapy (IMPT)

Intensity Modulated Proton Therapy is a form of Spot Scanning proton therapy, where the energies of proton beams directed from various angles are manipulated so that tumors of complex shapes can be precisely irradiated while minimizing the effect of radiation to surrounding healthy tissues.

Hokkaido University Hospital has collaborated with Hitachi in optimizing its treatment planning system to work seamlessly with IMPT for moving targets. By combining robust optimization designed to address inherent challenges in particle therapy treatments such as range uncertainties and treatment planning setup uncertainties with the tight dose distribution achieved through IMPT, the impact of moving targets can be minimized.

In August 2015, clinical use of IMPT began and has since been used for prostate, liver head & neck, and pediatric treatments. Plans are underway to further increase the number of treatable tumor types in accordance to accepted guidelines.

This announcement will be made at the upcoming 55th Annual Particle Therapy Co-Operative Group Meeting (PTCOG55) held in Prague, Czech Republic from May 22-28.

Hokkaido University Hospital, with their experience in radiation therapy and Hitachi, with their expertise in engineering design have combined their respective strengths in medicine and technology to offer cutting edge technology for cancer patients within the growing global market of proton beam therapy. Both organizations are committed to continued research and development to improve the quality of life of cancer patients through advanced proton beam therapy.

**Overview of Spot Scanning Technology**

Spot-scanning irradiation technology does not scatter proton beams as with conventional proton beam therapy. Rather, it repeatedly turns a narrow proton beam on and off at high speed as it progressively changes location to irradiate entire tumor volumes. Protons can be aimed with high precision according to the targeted tumors, even those with complex shapes, while minimizing the impact on nearby healthy tissue. Furthermore, customized equipment such as collimators and boluses are not required.

**Overview of Real-Time image Gated Proton Beam Therapy (RGPT)**

Real-Time image Gated Proton Beam Therapy is a technique used to track and irradiate tumors in motion. This is accomplished by positioning a gold marker, approximately 1.5-2.0mm in diameter, close to the tumor and establishing its location as a reference via CT. A dual-axis, orthogonal X-ray system is used with pattern recognition software to determine the spatial location of the marker due to respiration. Irradiation during treatment is performed only when the gold marker moves to within a small threshold of the planned irradiation location. This process, when repeated, can be synchronized to the respiratory motion of the patient, thereby significantly decreasing the total irradiation volume of targets in motion by approximately 1/4th to 1/2 compared to conventional irradiation techniques. As a result, the harmful impact of irradiation to healthy tissue can be significantly reduced.

**About Hokkaido University Hospital**

Established in 1921, Hokkaido University Hospital provides high quality medicine, cultivates competent persons in the medical field, promotes advanced medical technology, and seeks to contribute to the health and well-being of the community.

**About Hitachi, Ltd.**

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges. The company's consolidated revenues for fiscal 2015 (ended March 31, 2016) totaled 10,034.3 billion yen ($88.7 billion). The Hitachi Group is a global leader in the Social Innovation Business, and it has approximately 335,000 employees worldwide. Through collaborative creation, Hitachi is providing solutions to customers in a broad range of sectors, including Power / Energy, Industry / Distribution / Water, Urban Development, and Finance / Government & Public / Healthcare. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

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