Health Technology Review	
Technology Ref.:	HTA24035 Heavy Ion Therapy
Applicant's contact Email: **Mobile no:**	**Focal Point Name for Medical clinical operator:** Dr. Stephen R. Grobmyer, MD, FACS, Chairman | Oncology Institute Email: grobmys@clevelandclinicabudhabi.ae Mobile: +971-800 8 2223 **Focal Point Name for Medical device Manufacture:** Takeji Miyaoka Senior Manager, Particle Radiotherapy Business Project Engineering Department, First Project Engineering Group Email: takeji.miyaoka@toshiba.co.jp Contact Number: +81 50 3147 1639
Technology Name/Version/Model:	Heavy Ion Therapy / Model: CI-1000
Approvals by International Bodies (year):	Ministry of Health in Japan
Manufacturer/ Company name, country of Origin	Toshiba Energy Systems & Solutions Corporation / Japan
Agent in UAE:	Cleveland Clinic Abu Dhabi
Class/ Type	Category: Therapeutic radiation therapy device / Type: Technique, Procedure
Licensed Indications	Cancer Therapy for the following: • Adenoid cystic carcinoma • Mucosal melanoma • Non-small cell lung cancer • Liver cancer • Sarcoma • Recurrent tumors • Advanced gynecologic cancers • Esophageal cancer • Pancreas cancer • Prostate cancer
Cost and Comparisons with standard of Care	**Cost Effectiveness:** Studies have shown that Carbon Ion Radiation Therapy is cost-effective when compared to photon and proton therapies for various cancers, including chordomas, lung cancer, rectal cancer, and liver cancer. **Comparison with Standard of Care:** Carbon ion therapy offers a higher relative biological effectiveness and can reduce the number of treatment fractions compared to traditional photon and proton therapies.
Administration/ Use	Heavy Ion Therapy (CI-1000) is used for treating cancers that are resistant to conventional radiation therapies, such as photon and proton therapy.

	It is effective for a range of difficult-to-treat tumors including adenoid cystic carcinoma, mucosal melanoma, non-small cell lung cancer, liver cancer, sarcoma, recurrent tumors, and advanced gynecologic cancers.

Short Description of the Technology:	• Introduction. Heavy Ion Therapy utilizes carbon ions to deliver high doses of radiation to cancerous tumors with minimal damage to surrounding healthy tissues. This therapy is effective for treating tumors that are resistant to traditional radiation therapies and those located near critical organs. The therapy utilizes carbon ions, which provide high precision and minimal damage to surrounding healthy tissues. This allows for high-dose radiation delivery directly to the tumor, enhancing treatment and reducing side effects and shortens treatment times by using fewer, larger doses (hypofractionation), making it a convenient and efficient option for patients. Additionally, this therapy has shown to improve local tumor control, increase survival rates, and offer a non-invasive alternative to surgery for inoperable or recurrent cancers. • Mechanism of Action. The therapy directs a beam of carbon ions at the tumor, causing DNA damage and preventing cell division and growth, ultimately leading to cancer cell death. Carbon ions have a higher biological effectiveness than photons and protons, making the therapy more effective and shorter. • Clinical Evidence/ Efficacy. Over 47,000 patients globally have been treated with Carbon Ion Radiation Therapy. Numerous clinical trials, including over 69 phase I/II trials primarily from Japan, have demonstrated the therapy's efficacy in various cancers. - Key Studies and References: 1. Hwang EJ et al., 2020: Particle therapy outcomes and toxicity reviews. 2. Durante M et al., 2021: Physics and challenges of cancer therapy with heavy ions. 3. Malouff TD et al., 2020: Review of Carbon Ion Therapy technology. 4. Kamada T et al., 2015: Assessment of 20 years of clinical experience in Japan. 5. Sprave T et al., 2018: Cost-effectiveness of Carbon Ion Radiation Therapy for Skull Base Chordoma. Studies (PICO): 1. Population: Patients with difficult-to-treat cancers such as head and

	neck cancers, pancreatic cancer, soft tissue sarcoma, lung cancer, recurrent cancers, base of skull tumors, and other cancers resistant to traditional therapies. 2. Intervention: Heavy Ion Therapy using carbon ions. 3. Comparator: Traditional photon radiation therapy and proton therapy. 4. Outcomes: - Improved Local Control: Carbon ion therapy has shown improved local control rates compared to photon therapy, particularly in tumors like chordomas, which are known for their aggressive growth and resistance to conventional treatments. - Reduced Toxicity: The precision of carbon ion therapy results in less damage to surrounding healthy tissues, reducing the side effects commonly associated with radiation therapy . - Fewer Treatment Fractions: Carbon ion therapy can achieve therapeutic goals with fewer treatment sessions (hypofractionation), making the treatment process more convenient for patients and reducing overall healthcare costs. - Higher Biological Effectiveness: The higher relative biological effectiveness (RBE) of carbon ions enhances the therapy's ability to damage tumor DNA, leading to better outcomes in terms of tumor shrinkage and patient survival. - Cost-Effectiveness: The incremental cost-effectiveness ratio (ICER) for carbon ion therapy is compared to photon therapy, indicating that the additional costs are justified by the improved outcomes and quality-adjusted life years (QALYs) gained. • Safety/ Risk issues. Safety: less damage to surrounding tissues and a lower risk of secondary cancers compared to photon radiation therapy. No incidents or recalls has been issued. Potential Risks: The therapy carries similar risks to other radiation therapies, such as radiation-induced damage to adjacent tissues and organs, though these risks are minimized with heavy ion therapy. • Place in therapy/ diagnosis. Treatment for aggressive and recurrent cancers, in oncology and cancers centres.

Health Technology Assessment Team Recommendation:	Approved

Summary of Review:

Heavy Ion Therapy (CI-1000) is an advanced cancer treatment using **carbon ions** to deliver precise, high-dose radiation directly to tumors. This therapy is particularly effective for cancers resistant to traditional radiation methods, such as adenoid cystic carcinoma, mucosal melanoma, non-small cell lung cancer, liver cancer, sarcoma, and recurrent tumors. Its key advantages include:

1. Precision: The Bragg peak property of carbon ions ensures minimal damage to surrounding healthy tissues.
2. Efficiency: Hypofractionation allows for fewer treatment sessions, reducing overall treatment time.
3. Improved Outcomes: Provides better local tumor control and higher survival rates.
4. Safety: Offers a non-invasive alternative to surgery for inoperable or recurrent tumors, with reduced side effects.

We recommend an **approval of using this technology** for Market entry with the following conditions:

1. Establish clear criteria for selecting patients, focusing on those with tumors resistant to conventional therapies or located near critical organs, and define exclusion criteria to ensure the safety and suitability of patients for Heavy Ion Therapy.

2. Implement protocols for regular patient monitoring during and after treatment to assess response and manage side effects and develop a long-term follow-up plan to track patient outcomes and gather additional data on the effectiveness of the therapy.

3. Create and maintain a comprehensive training program for medical personnel, including radiation oncologists, biomedical and clinical engineers, medical physicists, and dosimetrists, to ensure the highest standards of care and safety in administering Heavy Ion Therapy.

4. Establishing a proper quality monitoring process and reporting of any adverse events or unwarranted consequences including safety issues of employees.
5. Provision of regular updates and reports about the product to DOH upon request.

Moreover, DOH has the right to stop the product at any stage if deemed necessary, initial conditions and any subsequent conditions must be satisfied before obtaining final approval. Failure to do so will reflect in provoking the approval.

Technology Image


Population, setting and intended user for Technology "Heavy Ion Therapy / Model: CI-1000"

- **Population/ Intended User**; Cancer patients and to be determined by the medical doctor.
- **To be performed by**: Oncology team including radiation oncologists, medical physicists, dosimetrists, and other specialists involved in cancer treatments.

  Clinical Setting: Specialized radiation therapy centers equipped with the necessary technology for Heavy Ion Therapy.
- **Condition of use:** For treating cancers resistant to conventional therapies or those located near critical organs, requiring precise targeting to minimize damage to healthy tissues.
- **Exclusion criteria:** Patients with medical conditions that contraindicate high-dose radiation therapy or those unable to tolerate the treatment regimen, and to be determined by the medical doctor.