



Expertise & Versatility.

Proteus®ONE



Key insights in this Solution Paper

IBA stands as the most reliable partner in proton therapy, committed to consistently exceeding the expectations of both current and future Proteus users

At IBA, we understand the critical importance of staying at the forefront of cancer treatment. Since our foundation in 1986, we have been leading the development of medical accelerator solutions and we have developed the most extensive network of proton therapy centers globally, with 75 projects^{*} either completed or in progress.

In the pages that follow, you will learn more about IBA's ProteusONE and how its versatility, together with IBA's expertise, make it the system of choice for a proton therapy center.

You will discover:

- How to bring all the clinical benefits of intensity-modulated proton therapy (IMPT) to a wide range of cancer indications
- How to capitalize on the fast door-to-door proton therapy treatment, with isocentric and remotely-operated streamlined workflow
- How to master complex cases with non-coplanar treatment beams and vertex beams
- How to expand your center's clinical capabilities, as shared by leading proton therapy centers
- How you can benefit from the high flexibility and modularity of your proton therapy system, from routine to research
- How ProteusONE's readiness for future innovations can maximize the long-term excellence of your center



This Solution Paper is primarily intended for

- Hospital Executives
- Radiation Oncologists
- Medical Physicists



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IBA, leader in Proton Therapy for over two decades and many more to come

In the ever-evolving landscape of cancer treatment, the future of precision medicine is now more accessible than ever before. Proton radiation therapy has increasingly become one of the advanced clinical modalities in the cancer-fighting arsenal, thanks to its unequaled precision in targeting tumor cells with minimal radiation exposure to surrounding healthy tissue¹.

Today, as pioneers, IBA's Proteus platform provides efficient proton therapy treatments, featuring streamlined workflows, and groundbreaking research capabilities, and we aim to make this treatment accessible to every patient who could benefit from it.

132,000 75+

patients treated with Proteus advanced technology**

proton therapy treatment centers installed and in development

53

of patients treated on proton therapy commercial systems to date**

As healthcare institutions aim to offer the most advanced therapies to their patients, we have developed ProteusONE, a state-of-the-art proton therapy system set to significantly advance cancer treatment. This compact single-room proton therapy solution makes high-precision cancer treatment more accessible than ever before.

*Data as of March 2024. **Data from IBA & PTCOG 2022, consulted in November 2023.

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When hospitals choose IBA's ProteusONE system, they're not just deciding on **unparalleled treatment precision;** they're opting for **unmatched expertise** and the **utmost versatility in proton therapy,** which they highly value [Fig. 1] ^{4*}. This choice guarantees that **every eligible cancer patient receives the highest standard of care,** while also generating a **positive halo effect** across the hospital's medical, educational, and research activities².

This is how ProteusONE users evaluate various proton therapy features:





Fig. 1: Evaluation of the level of importance of different proton therapy features, on a scale from 1 to 5, among worldwide IBA ProteusONE users in 2023, including medical physicists, radiation oncologists, radiotherapists and hospital administrators, from both public and private hospitals^{*}.

Join the league of pioneers who have harnessed the expertise and versatility of ProteusONE to create the future of precision medicine in cancer treatment.

*Data from the IBA Proteus user survey 2023.



Extensive proton therapy expertise

IBA's global leadership in proton therapy ensures the highest level of expertise is provided to patients and healthcare professionals involved in proton therapy cancer treatment and research. To support this, we have developed ProteusONE, a system designed with input from its users for optimal user experience.

Clinical benefits and treatment indications

IBA's most advanced proton therapy system, ProteusONE, utilizes pencil beam scanning (PBS) and supports Intensity-Modulated Proton Therapy (IMPT) to achieve maximum conformality in dose distribution around tumors. This precision ensures accurate treatment delivery while sparing more healthy tissue compared to conventional radiotherapy (Fig. 2), thereby **reducing unwanted side effects, lowering the risk of secondary cancers, and enhancing patients' quality of life**^{1,3,4}.



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Photons Protons Photons excess up to 25 gy

Fig. 2: Representative dose-distribution of IMPT and IMRT plans for the same patient with left-sided nasopharyngeal carcinoma and the result of a dose subtraction showing unnecessary radiation up to 25 Gy when using photons. (Images are courtesy of Dr. Nancy Lee, Radiation Oncologist at the Memorial Sloan Kettering Cancer Center, New York City, United States)

A two-thirds reduction in adverse events associated with unplanned hospitalizations was reported in patients treated with proton therapy plus chemotherapy, compared to conventional radiochemotherapy. This retrospective study included 1,483 patients with head and neck, lung, brain, esophagus, gastric tract, pancreas, duodenum, hepatobiliary, rectal, anal and gynecologic cancers ⁵.

These advantages of proton therapy help extend the variety of treatment indications and patient volume of a radiotherapy department. It does so by increasing the number of complex cases that can be safely and efficiently treated with proton therapy, including pediatric patients or patients needing re-irradiation, but also by liberating time on conventional radiotherapy planning, reducing pressure and waiting lists, so each and every eligible patient can receive a tailored treatment ^{6.7}.

The American Society of Radiation Oncology (ASTRO) has given clear guidance about health insurance coverage and medical necessity for proton therapy.

The clinical indications for proton therapy were categorized by the American Society of Radiation Oncology (ASTRO) in their Model Policies in two coverage groups. Group 1 includes indications for which health insurance coverage is recommended. Group 2 includes indications for which coverage is recommended only if additional clinical requirements are met, such as enrollment in a clinical trial approved by an Institutional Review Board or in a multi-institutional patient registry that adheres to Medicare requirements for coverage. The ASTRO Model policies consider the use of proton therapy reasonable in instances in which sparing the surrounding healthy tissue cannot be adequately achieved with photon-based radiotherapy and using proton therapy is of added clinical benefit to the patient. **Group 1** indications include, but are not limited to, ocular tumors, malignant and benign primary CNS tumors, primary or benign solid tumors in children, advanced and/or unresectable head and neck cancers, and re-irradiation cases. Group 2 encompasses all other indications, including, among others, thoracic, abdominal and pelvic malignancies, as well as breast and prostate cancers⁸.

A recently published cross-sectional study analyzed the use of proton therapy in 5,919,368 newly diagnosed patients in the US, from 2004 to 2018, who were eligible to receive proton therapy based on the ASTRO model policy. While the use of proton therapy has increased during this time, **only 2.2% of Group 1 eligible patients received proton therapy** in 2018 [Fig. 3]. Among them, less than 15% of children, adolescents and young adults diagnosed with Group 1 cancers were treated with proton therapy⁹.



Fig. 3: Percentage of eligible patients treated with proton beam therapy by ASTRO indication coverage groups.

These data underscore the positive trend in the adoption of proton therapy and emphasize the need to ensure that every eligible patient can benefit from its unparalleled precision.

IBA's Proteus technology has proven its clinical relevance by treating approximately 53% of all proton therapy patients worldwide*. **Hospitals utilizing IBA's ProteusONE system treat a wide range of cancer types, aligning with the ASTRO model policy** Currently, an insufficient number of eligible patients receive proton therapy. In the US,

97.8%

of patients with cancers for which health insurance coverage for proton therapy is recommended **do not receive this treatment**⁹.

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As the patient mix can vary from one center to another, influenced by both internal and external constraints, proton therapy systems must adapt to a hospital's needs and areas of expertise. Figure 4 illustrates the **high versatility and adaptability of Proteus systems in treating different patient case mixes,** with an average of approximately 20% pediatric cancers and >18% re-irradiation treatments. It highlights the patient mix of four international centers using IBA's Proteus systems, compared to the average mix of conditions treated by proton therapy in the US as reported by the National Association for Proton Therapy (NAPT)*.



Fig. 4: Diversity of patient mix in 4 medical centers using IBA's Proteus systems compared to NAPT latest data.*

 $\mathbf{\hat{O}}$

We chose a very simple case for our first treatment. To build our practice in a safe, thoughtful way, we chose to start with brain tumors which are relatively easy to immobilize. And then moved on to progressively more complex treatments such as abdominal and pelvic treatments, extensively head and neck treatments, lung cancer treatments and eventually some prostate cancers. We ramped up slowly, intentionally, so that our staff would have the experience to be outstanding at what they do.



DR CRAIG STEVENS

Chair of Radiation Oncology Corewell Health, Royal Oak, Michigan, United States



CLICK OR SCAN THE QR CODE TO DISCOVER THE DIVERSITY OF PATIENTS TREATED AT COREWELL HEALTH HOSPITAL, AS EXPLAINED BY DR CRAIG STEVENS

ProteusONE expands a hospital's capabilities to more eligible patients, bringing them, and to the medical team, the benefits of the unparalleled precision of proton therapy.

*NAPT data are available at https://www.proton-therapy.org/ and IBA users data is courtesy of the respective centers.

Non-coplanar and vertex beams

Among the arsenal of features contributing to proton therapy treatment precision, the use of non-coplanar treatment beams greatly empowers the accurate targeting of the tumor while sparing organs at risk (OARs). Non-coplanar beams provide additional degrees of freedom and are particularly useful in complex cases with irregular tumor anatomy and important sensitive OARs that need to be preserved ^{1,10}.

ProteusONE's open gantry allows 360° accessibility to the patient by combining its 220° rotating gantry with the supine robotic patient positioner. Users of ProteusONE take advantage of this high versatility: **we observe higher use of non-coplanar treatment beams among ProteusONE open-gantry users compared to configurations in a closed-gantry system** [Fig. 5]^{**}.



When analyzing the different combinations of gantry and patient table positions employed by users, we observe that **ProteusONE users employ more different combinations compared to closed gantry users,** for whom non-zero table rotations are more limited (Fig. 6).



Fig. 6: Illustrations of the combinations of patient table position and gantry position used in an open gantry system (left) and closed gantry system (right)

ProteusONE users capitalize on the non-coplanar capabilities of the system and take advantage of the higher degree of 3D freedom when choosing beam arrangements**.

** IBA internal data collected from IBA users.



The high versatility of ProteusONE is also illustrated by the frequent use of vertex beams – where the radiation is delivered cranially, with the patient table at 270° and the gantry at 90°, particularly useful for intracranial tumors. When comparing the percentage of sessions with at least one vertex beam in ProteusONE users to closed-gantry users, we observe a more frequent use of vertex beams in ProteusONE users (Fig. 7)*.



Fig. 7: Percentage of sessions with at least one vertex beam in the first 10 centers using the 270° patient table position among ProteusONE users (left) and closed-gantry system users (right).

* IBA internal data collected from IBA users.



ProteusONE's open-gantry configuration enables a facilitated treatment workflow vs. closed-gantry configuration (Fig. 8, next page). While most workflow steps are similar, ProteusONE shows a major advantage: **ProteusONE users can instantly verify the patient position with the oblique imaging system, whatever the table angle.** Closed-gantry users, on the other hand, need to insert the imaging equipment before using it and retract it again before starting irradiation. Moreover, inserting the imaging equipment is not possible for all table rotations in closed-gantry systems.



ProteusONE is excellent for non-coplanar beams due to its clearance, oblique imaging system and open geometries. The use of non-coplanar beams is more complicated in closed gantries.



DR XUANFENG (LEO) DING

Lead Medical Physicist Corewell Health, Royal Oak, Michigan, United States Other minor differences appear when preparing the equipment for a second treatment beam, as illustrated in a prostate cancer example: ProteusONE users rotate the patient positioner 180° instead of the gantry, while closed-gantry users rotate the gantry at 270°.



Fig. 8: Representation of typical two-beam prostate treatment workflow similarities and differences between an open-gantry system and a closed-gantry system.

The open structure of ProteusONE allows users to easily combine couch rotations with gantry rotations when treating complex irradiations requiring non-coplanar and vertex beams.

Fast door-to-door treatment time and LINAC-like workflow

IBA's ProteusONE system has been designed for the users by the users, to treat a high volume of patients effectively and comfortably, with a LINAC-like workflow (Fig. 9). The possibilities of remotely operating the system and imaging at the isocenter greatly contribute to reducing treatment time. Some hospitals implementing the ProteusONE workflow report an **average treatment time per patient of 16 minutes**, including patient setup, image guidance, treatment and electronic charting¹¹. The average treatment time may depend on hospital protocol and patient mix, as certain indications may require additional steps (anesthesia, large treatment volumes...) and, thus, longer times, independent of the Proteus workflow.

Treatment time as low as 11 minutes per patient for prostate cancer can be obtained with ProteusONE using 2 treatment beams at 90° gantry angle and 0° and 180° couch rotation, and the oblique imaging system*.



Fig. 9: Flowchart comparing proton therapy workflow versus conventional radiotherapy workflow. Similarities include the imaging possibilities, while differences include the patient mix, machine size and movements, the importance of beam arrangements. and the availability of remote workflow.

* IBA internal data collected from IBA users.





The main steps of the ProteusONE workflow are very similar to an already familiar LINAC workflow:

01 - Starting the treatment session

The treatment begins by initiating a patient treatment session in the Oncology Information System (OIS) which communicates with the adaPT Treatment Suite IBA software.

02 - Patient identification and setup

The patient's identity is verified, and they are placed on the patient positioner (couch), either directly at the isocenter or in a separate, customizable, loading position – which is particularly useful for patients under anesthesia. Immobilization devices are added, and the couch is moved to the desired initial treatment position and adjusted using lasers, surface guidance or predefined positions stored in the software.

03 - Verification with imaging

The setup position can be verified using various imaging techniques, including CBCT, 2D orthogonal imaging, and oblique imaging. The oblique imaging system is fixed and provides instantaneous imaging whatever the couch or gantry rotation, while the 2D orthogonal imaging and CBCT systems share the same hardware, attached to the gantry (Fig. 10). These techniques are calibrated for the imaging isocenter to match the treatment isocenter, so the patient doesn't need to move anymore after image verification, saving time and potentially imaging doses. Users can choose which imaging technique to use, and the verification can be done from the treatment room or remotely, from the treatment control room. When performing verifications from the treatment room, users can apply corrections using the wireless hand pendant. Corrections are calculated manually or through a matching algorithm in the adaPT Insight software, based on the shift between the X-ray/CBCT image with the DRR/CT, then verified and validated to reposition the patient at the correct isocenter. This setup is saved and the corrections are propagated to subsequent treatment beams.



Fig. 10: CBCT, 2D orthogonal imaging and oblique imaging systems in ProteusONE. The imaging isocenter matches the treatment isocenter.

04 - Starting irradiation

With the patient correctly positioned, the user selects a treatment beam. The equipment is placed in the prescribed position, and any necessary beam modifiers, such as a snout or range shifter, are added manually but can be operated remotely. Further patient position verification is optional. The user initiates the irradiation, repeating this process for all prescribed treatment beams.



ProteusONE helps achieve low treatment time per patient without compromising the treatment quality, through its LINAC-like workflow, remotely-operating capabilities and imaging at the isocenter.



Streamlined QA workflow

IBA Dosimetry's leadership in treatment verification and quality assurance (QA) provides a full range of innovative, high-quality solutions and services that maximize efficiency and minimize QA errors in Medical Imaging, Radiation Therapy, and Proton Therapy. As part of the same organization, **the synergy between IBA Proton Therapy and IBA Dosimetry ensures seamless integration, improved efficiency, and substantial time and quality gains during clinical commissioning and daily operations.**

This collaboration also aligns the development roadmap for dosimetry and proton therapy future innovations such as DynamicARC[®]*, ConformalFLASH[®]*, and Adaptive PT.

ProteusONE users enjoy exclusive benefits such as:

Faster machine QA with Dopa Automation Server

which allows the MyQA platform to communicate with the IBA Proteus Gantry, Beam Delivery, Imaging, and Patient Positioning Systems. This streamlines the daily machine QA process by introducing automated communication, saving clicks, and preventing user error which ensures a daily QA time reduction from 15 minutes to less than 10 minutes.



Faster commissioning and machine QA with myQA Phoenix

IBA's high-resolution digital detector array that measures and verifies beam characteristics such as spot size, spot position, and gamma analysis. It can be installed onto the IBA-dedicated nozzle holder to automatically rotate with the gantry, speeding up calibration, commissioning and QA activities. Beyond efficiency, it improves overall safety by allowing to perform QA at any gantry angle, as recommended by the latest guidelines¹². Finally, it enables to use the same myQA Phoenix device for isocentricity QA, avoiding the need to purchase another detector for this unique verification.

Faster patient QA with myQA lon

The first and only patient QA solution that provides detailed plan comparisons by combining Monte Carlo independent 3D dose calculation, unique machine log file 3D reconstruction, and dose output measurements. For IBA Proteus users, it accesses complete irradiation logs of the Proteus system and compares the treatment plan to the actual dose delivered to the patient, through gamma analysis and spot maps. Its task-based workflow, automation and the latest webbased software technologies contribute to increasing QA efficiency, by allowing to minimize in-room measurements for patient QA, while also ensuring patient treatment safety.

ProteusONE users benefit from the seamless integration, improved efficiency, and substantial time and quality gains during clinical commissioning and daily operations provided by the synergy between IBA Proton Therapy and IBA Dosimetry. This synergy also supports the joint roadmap for groundbreaking innovations such as DynamicARC^{®*} and ConformalFLASH^{®*}.

*ConformalFLASH® and DynamicARC® are registered brands of IBA's Proton Therapy which are currently under research and development. ConformalFLASH® and DynamicARC® will be available for sale when regulatory clearance is received. Due to a continuous research and development program, IBA reserves the right to make changes in design, technical descriptions, and specifications of its products without prior notice. Some features are under development and may be subject to review by competent authorities.



Phoen/x



Clinical capabilities and "halo" effect

ProteusONE greatly contributes to the expansion of the treatment possibilities of a hospital. It provides unparalleled precision and dose conformality, fast and efficient treatment time, and non-coplanar treatment beams, including vertex beams, to treat complex tumors with irregular anatomy and close to sensitive OARs. ProteusONE gives physicians the flexibility to choose the best radiotherapy and proton therapy treatment options for their patients.

Adding a proton therapy system to a hospital can also have a **positive "halo" effect** on the radiation oncology department, illustrated by²:

- an increase in the number of patients referred to the hospital, including complex cases such as CNS or pediatric tumors
- an increase in the number of patients treated
- an increase in proton therapy-related research projects and grant opportunities



32 % New Patient Start (NPS) volume increase¹³



27% photon & proton patient starts increase¹⁴



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20 % new radiotherapy
patients increase<sup>15</sup>
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Discover the benefits that IBA users have experienced when adding ProteusONE to their hospital's capabilities:



The establishment of a proton therapy center not only serves patients but also significantly increases the reputation of your university hospital.

More people will know about our hospital's proton therapy technology and equipment, which will attract more patients.

However, not everyone is suitable for proton therapy, and some may need surgery, drug treatment, or photon therapy.

Generally, it increases our attractiveness for patients.



JENG-FONG CHIOU M.D., PH.D.

Director & Professor of Proton Center TMU Proton Center, Taipei Medical University Hospital Taipei, Taiwan Highlighted advantages:

- Ramp up to 20 patients/day in the first 5 months
- No treatment canceled due to machine downtime, with >98% uptime
- Important halo effect, with >39% of patients traveling >50 miles and an average of 27 calls/ month of patients requesting proton therapy
- _ Opportunities that proton therapy brings for research and clinical studies



Senior Director, Radiation Services

University of Kansas Cancer Center, Kansas City, United States



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Highlighted advantages:

- Consider proton therapy to treat complex tumors and more disease sites that were challenging to treat with limited toxicity
- Positive impact of a mindset of constant improvement, quality assurance, and setup accuracy on the photon radiotherapy site



DR LANE R. ROSEN

Director of Radiation Oncology Services Willis-Knighton Cancer Center, Shreveport, Louisiana, United States



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ProteusONE's unrivalled versatility

Today, ProteusONE is the most versatile proton therapy system on the market. Its high modularity allows users to select the best configuration for routine clinical treatments but also for research. Its unmatched interoperability opens up the possibilities for choosing ancillary partners, enabling the possibilities of evolution to ensure short-, mid- and long-term value for patients, staff and hospitals.

Modularity and flexibility, from routine to research

ProteusONE users have the possibility to capitalize on the system's versatility to adapt to a wide range of treatment configurations, from pediatric to adult patients, and from more complex to easy-to-treat tumors.

- The PBS precise dose delivery can be combined with the dimensionally accurate imaging of 3D CBCT to enable image-guided IMPT, allowing physicians to truly control the intensity and spatial distribution of the proton dose while tracking where protons target the tumor cells.
- Users can choose between the different imaging systems (Fig. 10) available to image at the isocenter and patient verifications can be done from the treatment room, using the wireless hand pendant, or remotely, from the control room.
- The different combinations of gantry position and patient table position expand the possibilities of treatment beams available to precisely target tumors, including non-coplanar and vertex beams, and allow staff to easily access the patient during positioning and imaging.
- The modular software platform, adaPT Treatment Suite, enables different treatment techniques, editing treatment plans and prescriptions for standalone irradiations or QA, along with interoperability with different Treatment Planning Systems (TPS) and Oncology Information Systems (OIS).
- **Patient and staff experience is enhanced** by fostering a soothing environment thanks to the Philips Ambient Experience, an environmental feature that keeps patients relaxed and comfortable, increases staff working comfort and improves patient-staff interaction.

With the installation of ProteusONE, users get more than just a system, they embark into a true partnership with IBA and **get support at every step of the process**: from room design to daily operation including maintenance, training, education and upgrades.

Optimal integration and interoperability

IBA is the most experienced and broadest integrator of multiple partners in proton therapy. Our open vendor strategy allows full flexibility to the users so they can select OIS and TPS vendors as well as treatment couches and patient monitoring systems based on their preferences and/or fit with their current ecosystem.



Since we have various vendors in the center, we were trying to integrate different technologies. That was one of the unique things that we found very useful with IBA who has an open vendor strategy.



DR ALONSO N. GUTIÉRREZ

Chief of Medical Physics Miami Cancer Institute, Florida, United States

Readiness for future innovations

The installation of ProteusONE provides users with unmatched long-term value for the next 20+ years. It is designed to remain compatible with upcoming proton therapy innovations, ensuring that centers are future-proofed for years to come. Our expertise in accelerator systems and our unequaled beam quality ensures ProteusONE is ready to integrate future solutions to come such as:



DynamicARC®*, a novel dynamic beam delivery technique, from multiple directions, while the gantry is rotating, enhancing tumor coverage and healthy tissue sparing.



CLICK OR SCAN THE QR CODE TO ACCESS TO THE VIDEO



ConformalFLASH®*, a technique with the potential to greatly shorten treatment time while reducing toxicity and expanding the therapeutic window.



CLICK OR SCAN THE QR CODE TO ACCESS TO THE VIDEO

On top of our longstanding relationship with our clinical partners, we also **co-invest with our corporate partners** in continuing to develop best-in-class systems and integrating treatment solutions to ensure the patient continuum of care:

- We leverage proton therapy and radiotherapy synergies, ensuring a seamless path to care for patient and healthcare team with **Elekta**;
- We redefine workflow data management through open architecture, seamless interfaces and ultrafast processing power with RaySearch Laboratories;
- We co-develop hardware, and software for the most advanced imaging capabilities and optimization algorithms with **Philips.**
- We commit to a joint development roadmap to ensure improved efficiencies and time and quality gains when implementing future innovations, with **IBA Dosimetry.**

With IBA's ProteusONE, you create the future, elevate your center and change the lives of your patients and team for decades to come.

*ConformalFLASH® & DynamicARC® are registered brands of IBA's Proton Therapy which are currently under research and development. ConformalFLASH® and DynamicARC® will be available for sale when regulatory clearance is received. Due to a continuous research and development program, IBA reserves the right to make changes in design, technical descriptions, and specifications of its products without prior notice. Some features are under development and may be subject to review by competent authorities.

Essential takeaways

IBA's unequaled expertise and ProteusONE's unmatched versatility help elevate a center's capabilities to provide the most advanced proton therapy treatment, so patients can keep everything but cancer.

By adding ProteusONE to your radiation oncology department, you will:

- Expand your center's cancer treatment capabilities to more eligible patients, bringing them, and to the medical team, the benefits of the unparalleled precision of proton therapy
- Capitalize on the non-coplanar capabilities of the system and take advantage of the higher degree of 3D freedom when choosing beam arrangements for complex irradiation treatments.
- Benefit from the seamless integration, improved efficiency, and substantial time and quality gains during clinical commissioning and daily operations
- Take advantage of its high modularity and benefit from the flexibility you need to excel at running
 your practice at any time
- Ensure optimal integration for an enhanced patient workflow
- Maximize the long-term excellence of your center thanks to its readiness for future innovations

Contact us !



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Available resources

This Solution Paper is part of a series highlighting the unique benefits of proton therapy with ProteusONE for cancer centers:



Patient & Staff Experience



Expertise & Versatility



Peace of Mind



Why Beam Quality Matters



Scalability & Sustainability



Proton Therapy Center Development - Synthetic Guide





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