If the whole world can do it, why not we? And why don't we?

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The last few decades saw several significant technological advances happening in the field of radiation oncology. The multileaf collimators (MLCs), initially introduced for simple field shaping in 3-dimensional conformal radiotherapy, soon evolved into a tool for delivering intensity modulated radiotherapy (IMRT). Within years IMRT delivery technology further expanded to include volumetric modulated arc therapy (VMAT) in which again MLCs play the most important role. Dose calculation algorithms became stronger, accurate and faster with the introduction of better algorithms based on first principles and powerful computers. Treatment delivery through stereotactic methods became a norm and saw several modern gadgets like Gamma Knife, linac-based radiosurgery units like CyberKnife, and ZAP-X radiosurgery system. The current century saw the introduction of O-ring gantry linacs like Tomotherapy, Halcyon, etc. The practice of image-guided radiotherapy (IGRT), started in the early 1990s with ion chamber-based portal imaging, has advanced today into various practice forms with most modern solid state detector technology. Image guidance theory has grown by leaps and bounds to incorporate online adaptive radiotherapy (ART) which is the buzz word today. There are MR-guided treatment delivery machines like Unity and other advanced technologies available for the purpose. Particle radiotherapy using protons, once confined only to research facilities, has reached several clinics across the world. Lately, artificial intelligence (AI) has made its presence felt in every step of the radiation oncology workflow - be it in triaging, contouring, automated treatment planning, plan evaluation, plan check, adaptive treatment planning, AI has made a big impact in every area of the treatment process.

The radiation oncology community in South Asia has been quick enough to adapt all these technological advances in radiation oncology within no time of their inventions and make them available to the common public across wide regions. In this regard, the reach of image-guided IMRT and VMAT is a good example. These advanced treatment technologies are so widespread in this region that almost every patient from these countries has easy access to them. While there are Tomotherapy units available in India, Bangladesh, Pakistan, Sri Lanka, Nepal CyberKnife and MR-guided linac facilities are available in multiple centers in India and Pakistan. India otherwise has been in the forefront in bringing advanced technologies like proton therapy, and ZAP-X radiosurgery unit with many more facilities slated to come up in the near future including three new proton centers.

However, if there is one simple technology which is found grossly lacking in this entire region, it is the simple paperless workflow in radiation oncology. Unlike in the western world, where every center works on paperless environment, the South Asian radiation oncology centers have

simply opted to ignore them, barring a few exceptions in India. This is in spite of the fact that every center has invariably a radiation oncology information system (ROIS), like MOSAIQ or Aria or their equivalent. The hard-to-digest truth is that in these centers the ROISs are used like 'improvised' record and verify (R&V) systems. In this way the system is used more or less in the same way it was used way back in the early eighties when R&V systems first appeared in the radiation oncology field.

If a properly designed survey is ever to be conducted, it would for sure go on to reveal how naive radiotherapy personnel in the South Asian region are when it comes to knowing about the true potentials of a ROIS. Beyond the routine scheduling and handling of all treatment and imaging sessions, the capabilities of a ROIS are hardly known to anyone.

The biggest challenge in any radiation oncology department is the chase behind the physical radiotherapy file (simply known as RT file) by one and all. It is needed at multiple locations by multiple people - by the radiation oncologist in the review room; by the therapy technologist in the treatment room; by the physicist in the treatment planning system's (TPS) room; and by the radiation oncology nurse in the preview/vitals room - all at the same time. Being a physical chart, it is obvious that such a chart cannot be omnipresent everywhere! The chart contains, besides other things, basic demographical data of the patient, patient's diagnosis, clinical workup notes, referring physician's remarks, clinical notes from other departments if any, histopathological reports, all radiological investigations, blood chemistry reports, radiation dose prescription, daily treatment records, cumulative dose until date, daily vitals, progress notes by treating physicians, details of previous treatments if any, morbidity chart, printouts from TPS, discharge summary, etc. The American Society of Radiation Oncology has stressed the importance of converting this chart as an electronic health record (EHR) in its publications (Safety is No Accident, 2012, and 2019).

How can we make a physical chart into a EHR? How can we make it omnipresent and obviate the need for its physical presence everywhere? Answer: Go the ROIS way! Not only that each of the information mentioned above can be entered into ROIS making the physical chart redundant, but also being a computerized record, it is available in any computer at any location. There is no need to run behind the physical file. Further, access to data can be restricted based on the operating person's credentials, thus enhancing patient data privacy. For example, while the treating physician would have unrestricted access to all the data, a radiation oncology nurse would have access only to the demographic data, daily vitals section and perhaps progress notes.

The diagnosis entry in ROIS is where one enters every detail of the disease. Depending on the disease site, the diagnosis entry page has extensive provisions for entering International Codes of Diseases (ICD), T(umor) N(odes) M(etastasis) staging, descriptions on details of tumor size,

location, lymph node involvement, etc., that can prove valuable at the time of patient data analysis. Reports of the radiological and pathological investigations, blood chemistry reports, if properly configured, can be directly imported from the hospital information system (HIS) in the highly preferred soft format, or in the hard format in the form of scanned documents. Users can raise investigation requests from within ROIS (like blood chemistry, radiological, etc.,) as and when the need arises, thus making the use of HIS or form-based requisitions unnecessary. Every instance of patient's visit to the hospital, every footfall within the department can be captured electronically and record kept forever. One can go on to 'build' intelligent forms, using simple customized dropdown menus, radio-buttons, checkboxes, free-text entries, to address the needs of the departmental workflow and enforce the same for strict compliance. For example, the whole process of mould preparation, chart-check by physicists, the second-check by radiotherapy technologists (RTTs), etc., can be enforced on staff through mandatory filling-up of forms. These forms will go as part of the patient's electronic medical record (EMR). By thoughtfully configuring the forms and enforcing their digital filling at right locations in the electronic workflow, patient safety is enhanced.

The ROIS can also be used to manage patients, manage availability of physicians, physicists, and therapists in the department through incorporation of their leave schedules. Besides that, the system can also manage facility infrastructures like usage statistics of thermoplastic masks, vacuum cushions, slot-booking for hospital's common facilities like outpatient department (OPD) rooms, seminar room, etc. These valuable features of ROIS prevent confusions and oversights that can result from manual workflow.

'Paperless' is a big misnomer for ROIS. Calling it 'paperless' often shifts the focus from its main advantages, viz., enhanced patient safety and valuable data mining, to its trivial gain of saving paper sheets, making people to wonder why should so much efforts be made for the sake of saving a few sheets of paper. Indeed, the correct way is to call it either 'electronic health record' or 'electronic medical record' and the system should always be referred as 'radiation oncology information system'. The radiation oncology workflow is one of the most complex ones involving several human interactions and information exchanges extending over a wide time scale. A complex workflow that relies heavily on paperwork and person-to-person interactions makes it vulnerable to human errors. If it is converted into an electronic one, enabling introduction of appropriate forms/checklists at various stages in the process to plug all the loopholes, it will prevent errors from reaching the patient. This also will enable mining of precious data which otherwise go down the drain unharnessed. For example, it is possible to know 'How many patients did we treat today / this week / this month / this year?', and split those numbers according to machine, treatment energy, treatment technique, treating consultant, from a few mouse clicks. It is also possible to generate data on treatment statistics like 'How many are supposed to start treatment today?', 'how many computed tomography

(CT) simulations done today?', 'how many patients would complete their treatment on a particular day, or during a specific window period?' through minimum efforts. Data mining can be further expanded to capture machine downtime and the reasons thereof, which can add valuable insight into downtime analysis, thus enabling timely preventive measures.

One of the 'bottlenecks' often faced by radiation oncology staff is the correct and timely update of the 'white board', showing the current status of the treatment planning process for each patient. Missed out and delayed updates often lead to delayed treatment and patient dissatisfaction. This happens mostly because of improper communications, overlooking assigned responsibilities, delays in task completions, etc. The ROIS can effectively replace your departmental white board. Its care path tracking feature can remove all these bottle necks. Once the demographics data of a patient, slated for receiving radiotherapy course, are entered into the system, the entire care path for that patient - mould room task, CT simulation task including image exporting to the TPS, image importing and adding structure sets in the TPS, contouring, adding dose constraints and dose prescription by the physician, treatment planning task, patient specific quality assurance task, adding treatment and imaging sessions in the ROIS, completion of treatment and generation of discharge summary report - every step in the radiation oncology workflow can be automatically added in the patient's care path along with the responsible person and the specific timeline for completing each task. Upon completion of each task, it is the responsibility of the concerned person to change the status of the task in ROIS to 'COMPLETED' status which will shift the responsibility automatically to the next assigned person in the care path queue. In this way everyone becomes aware of his/her pending responsibilities and the respective due dates. The ROIS opening screen for everyone can be configured to display 'white board' showing the progress status of the care paths for all patients, along with the currently pending task and the name of the responsible person. This makes it easier for everyone to view the whiteboard from his/her own desktop and also its live update.

The ROIS can be configured to improve patient's experience in the hospital in many ways. For example, when the patient arrives in the department for daily treatment, all that he/she has to do is to simply scan a barcode affixed on the appointment card. This simple action will record the arrival time of the patient in the hospital and make it known to everyone in the department that the patient has arrived and is waiting. It is also possible to fetch data on the waiting time spent by patients on each day of their visits and address issues related to long waiting time.

In the routine workflow verbal instructions are often given and at times such instructions are missed due to oversight resulting in deficiency in timely clinical care provided to the patient. Such instructions can be issued over ROIS making it mandatory for the concerned staff member to acknowledge the same through digital sign.

In spite of all these advantages, radiation oncology centers in the South Asian countries have not yet adapted this simple technology. There are a few exceptions in India, but they are

negligible in numbers. The hard truth is that more than 99% of the centers are still relying on paper-based workflow, compromising efficiency and patient safety in many respects. There are multiple reasons for not adapting ROIS-based workflow by clinics in this region:

1. One of the important impediments is the lack of awareness among radiation oncologists, medical physicists, radiotherapy technologists and radiation oncology nurses about the capabilities of ROIS. Many of them still consider it as a simple record and verify system to deliver treatments correctly and do not explore the ways to effectively use the system for improving the workflow.
2. In many centers it is mandatory for departments to follow HIS, which is either in-house developed or purchased. The hospital's management issues compulsory instructions that all clinical notes, clinical history, all investigation requests must be entered/initiated through HIS only. The radiation oncology department is no exception to these instructions and staff in the department do not like to double their responsibilities by duplicating their work on both HIS and ROIS. They simply stop at HIS and choose to ignore ROIS. The onus is on the radiation oncology team to educate the hospital management that (i) the radiation oncology workflow is unique and different from others; (ii) both HIS and ROIS are hospital information systems and ROIS, in addition to being a HIS, can address many unique needs of oncology workflow which cannot be met by a simple HIS; (iii) the two systems can be configured to exchange information mutually between them as per specific needs; (iv) following ROIS-based workflow will enhance patient's safety and patient's experience and (v) valuable data can be generated from ROIS which otherwise will down the drain.
3. The radiation oncology staff are unwilling to come out of their comfort zone - i.e., the paper-based workflow. They have to know that once they are used to ROIS-based workflow, they will start to wonder how all these years they lived without it!
4. The lack of infrastructure is another stumbling block. Neither the required licenses, nor the required number of additional workstations are bought by the centers.
5. The lack of coordination between hospital's information technology (IT team) and the radiation oncology team. Often the hospital's IT team fails to grasp the intense needs of the radiation oncology department and consider it one among all other departments.
6. The need for having a robust mechanism for backing up the ROIS data.

It is high time that the radiation oncology centers in the South Asia realized the true potentials of a radiation oncology information system like MOSAIQ or Aria and adapt this simple technology into their practice. Even more importantly, these centers should appreciate the inherent hazards associated with the paper-based system that is in wide practice currently in this part of the world. Time has come for us to ask ourselves: If the whole world can do it, why not we? And why don't we?