No conflict of interest

Learning objectives

- To review and critically discuss plan optimization and procedure optimization
- To touch onto patient experience and outcome from a physicist perspective.

INTRO – OR "HOW DID WE GOT HERE"

- The brachytherapy practice of today has built on decades of successful clinical experience, relying on clinical knowledge sublimated in collections of rules called 'systems': Stockholm, Paris, Manchester, Fletcher.
- These systems described, sometimes in great details, **how** things should be done; they represent practice not theory.
- This approach had a lot to do with reproducibility of treatments that were clinically successful and little to do with understanding of how things work, **why** a certain placement of radioisotopes actually works and explaining the mechanism behind.

MODERN ERA – 3D and DVH

- The modern era pretty much coincides with the introduction of CT in the 1970s.
- We learned how to compute radiation transport through the body very accurately and to describe our plans by employing dose volume histograms (**DVH**).
- Having now a ***set of DVH parameters that describe a dose distribution***, one is in the position of ***optimizing that distribution*** by simultaneously maximizing those parameters to some structures (anatomical or disease related) while minimizing other parameters to structures related to normal anatomy, which typically one tries to spare.


ELSEVIER Brachytherapy 11 (2012) 47–52

American Brachytherapy Society consensus guidelines for locally advanced carcinoma of the cervix. Part II: High-dose-rate brachytherapy

Akila N. Viswanathan[1,*], Sushil Beriwal[2], Jennifer F. De Los Santos[3], D. Jeffrey Demanes[4], David Gaffney[5], Jorgen Hansen[1], Ellen Jones[6], Christian Kirisits[7], Bruce Thomadsen[8], Beth Erickson[9]

[1]Department of Radiation Oncology, Brigham and Women's Hospital and Dana Farber Cancer Institute, Harvard Medical School, Boston, MA
[2]Department of Radiation Oncology, University of Pittsburgh School of Medicine, Pittsburgh, PA
[3]Department of Radiation Oncology, University of Alabama, Birmingham, AL
[4]Department of Radiation Oncology, David Geffen School of Medicine UCLA, Los Angeles, CA
[5]Department of Radiation Oncology, Huntsman Cancer Center, University of Utah, Salt Lake City, UT
[6]Department of Radiation Oncology, University of North Carolina, Chapel Hill, NC
[7]Department of Radiotherapy, Medical University of Vienna, Vienna, Austria
[8]Departments of Medical Physics and Human Oncology, University of Wisconsin, Madison, WI
[9]Department of Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI

The term optimization refers to the sophisticated process of achieving certain dose values at points or volumes within the implant; it is not the simple generation of a standard dose distribution by using fixed dose points located around the applicator.

To optimize …or not.

- "With 3D dosimetry, matching the dose distribution to the high-risk clinical target volume (HR-CTV) while simultaneously avoiding the OAR can be challenging."
- "**Optimization should be performed with caution** by observing changes in the dose, dose/volume parameters, and the spatial dose distribution that results from the modified loading pattern. **The exclusive use of dose volume histogram (DVH)-based parameters to select a source loading is not recommended** because substantial and perhaps undesirable changes in the spatial dose distribution may occur. Hot or cold spots in the target region and in non-contoured OAR, such as the vagina, connective tissue, nerves, vessels, or the ureters, may result."
- "With inverse or graphical optimization, the dwell times of the intracavitary and interstitial parts should be controlled by the physicist because most optimization algorithms do not take into account the spatial dose distribution."

Plan Optimization for Cervical Cancer

Review article Cancer/Radiothérapie 22 (2018) 345–351

3D brachytherapy for cervical cancer: New optimization ways

Col utérin : curiethérapie tridimensionnelle et nouvelles voies d'optimisation dosimétrique

I. Fumagalli[a,b,*], C. Haie-Méder[a,b], C. Chargari[a,b,c,d]

[a] Brachytherapy unit, Department of Radiation Oncology, Gustave-Roussy, 114, rue Édouard-Vaillant, 94805 Villejuif, France
[b] University of Paris-Saclay, 114, rue Édouard-Vaillant, 94805 Villejuif, France
[c] Molecular Radiotherapy, UMR0, Inserm, 114, rue Édouard-Vaillant, 94805 Villejuif, France
[d] Institut de recherche biomédicale des armées, DYS, 91220 Brétigny-sur-Orge, France

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ABSTRACT

Brachytherapy has known major improvements in recent decades. It represents an essential component of local treatment of cervix cancers. One major breakthrough was the advent of 3D imaging for image-guided brachytherapy. Doses could be prescribed to volumes. This allows better delineation and coverage of target volumes, as well as organs at risk (bladder, rectum, sigmoid) protection. Local recurrences have been consequently reduced and survival has been improved. In addition, improvement and development of new applicators have facilitated the delivery of interstitial treatments. Afterloading applicators, associated with 3D imaging, allow dosimetry optimization in order to improve the coverage of the target volumes (dose in 90% of the high risk clinical target volume) and to limit dose to the organs at risk. In the future, more personalized treatments will be achieved through more advanced applicators and/or by improving the accuracy of imaging at the time of brachytherapy.

3-4 Optimization

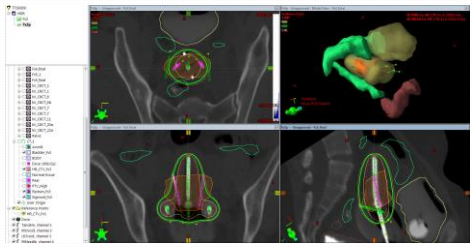
"Manual optimization relies on the possibility to activate dwell positions and to modulate dwell times on different locations of the catheters and/or to add interstitial needles in order to improve the dosimetry."

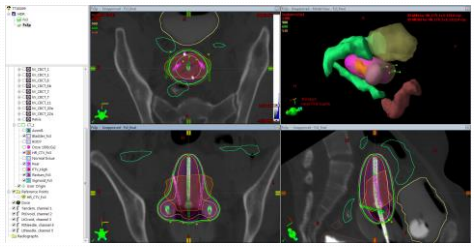
…

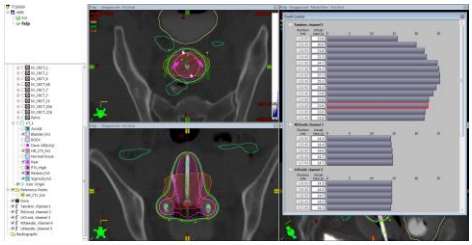
"In order to provide fast and automatic solutions for dose optimization, inverse planning approaches have been proposed. However, **this approach could generate heterogeneity in dwell time values** with hot points. If used, caution is required. **In general, inverse planning is not recommended and manual optimization is preferable**. Chajon et al. reported comparison between manual optimization method an inverse planning simulated annealing on thirty patients [46]. They found similar D90, D100 and V100 with both methods but a heterogeneous distribution with inverse planning simulated annealing."

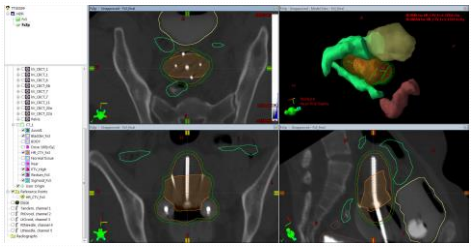
ONE SOLUTION

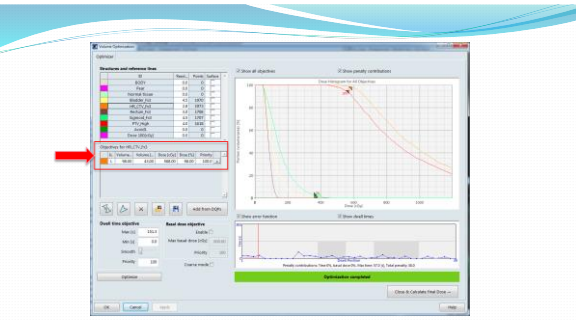
"The difficulty in pursuing an exclusive dose/volume based optimization stems from the fact that the structures involved explicitly in the planning (high-risk clinical target volume [HR-CTV], rectum, sigmoid, and bladder) and those involved implicitly (uterus, vagina, ureters, and connective tissue) are not enough to drive, by themselves, an optimizer toward a standard pear-shaped dose distribution."

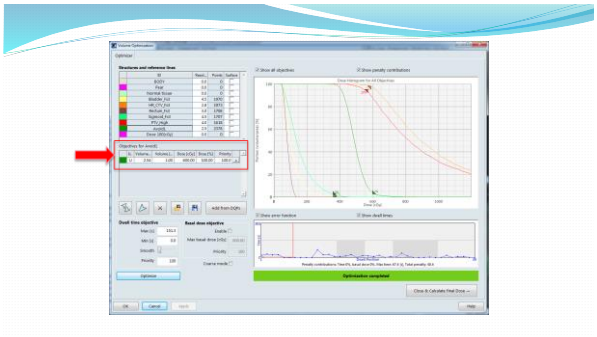


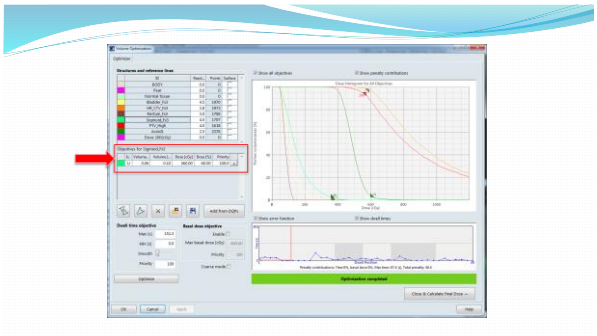


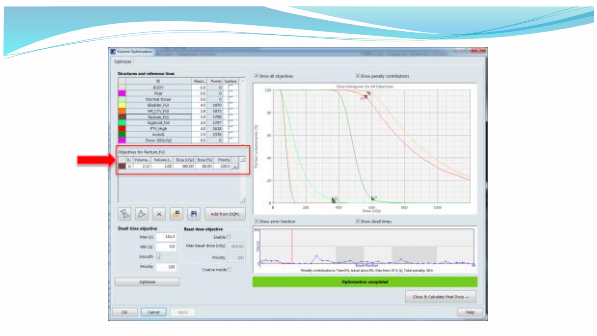


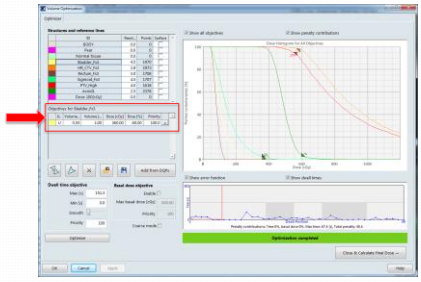


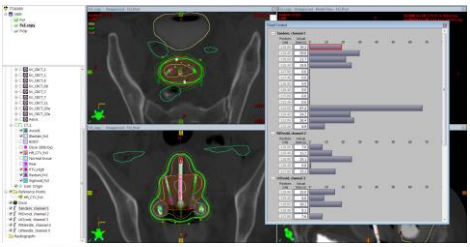


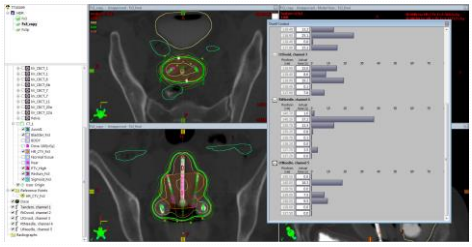


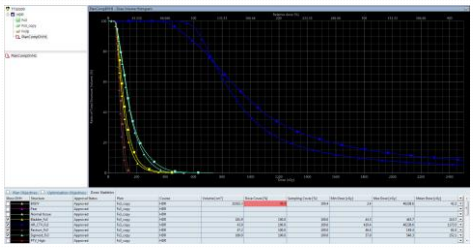


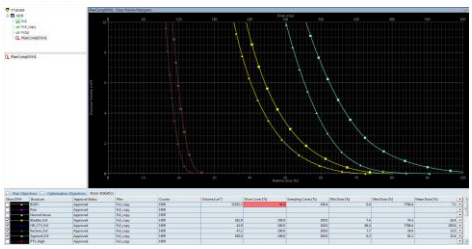




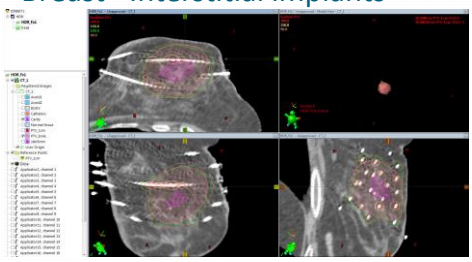


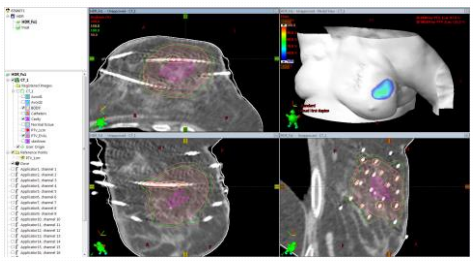


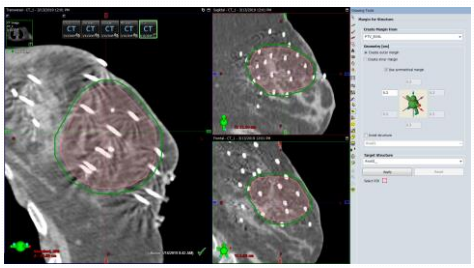


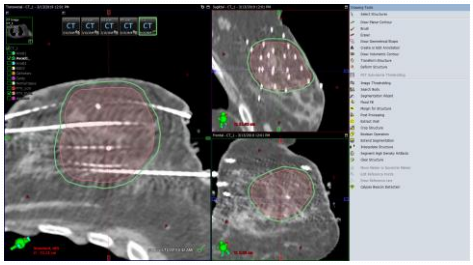


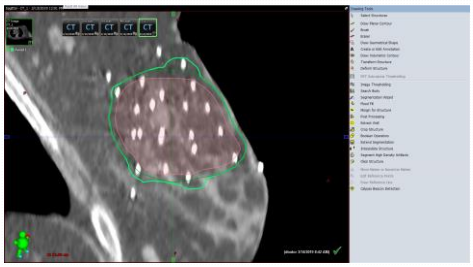
Breast –Interstitial implants

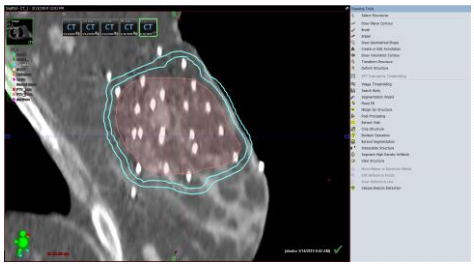


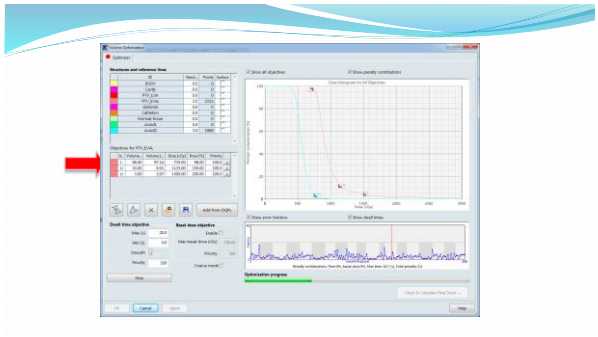


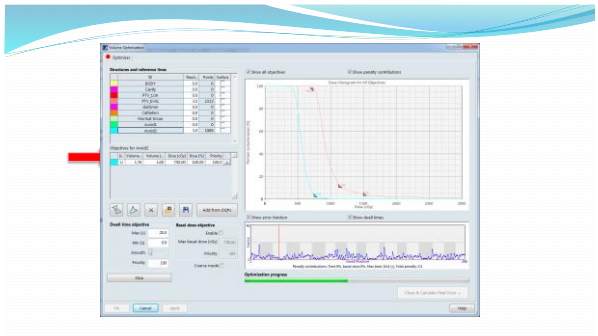


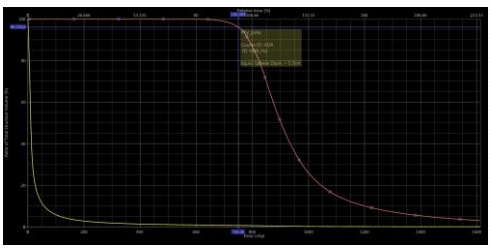


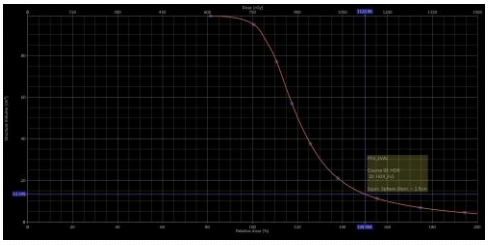


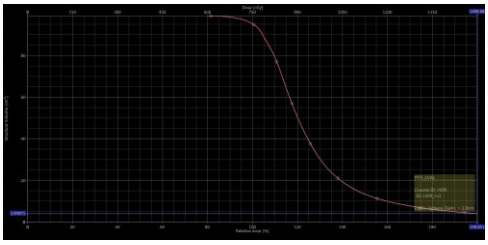




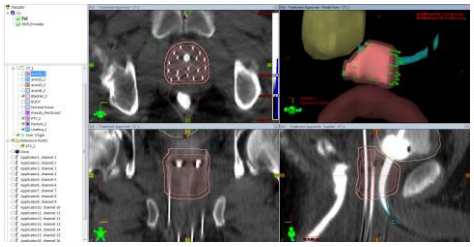


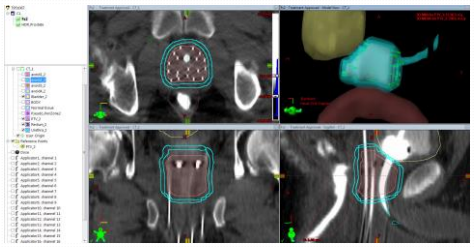


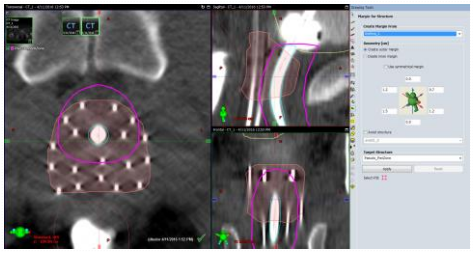


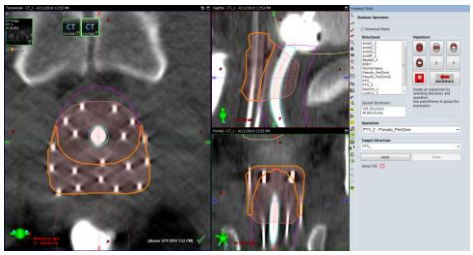


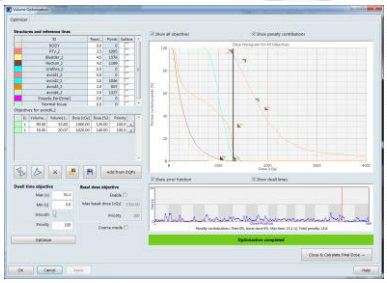
Prostate HDR

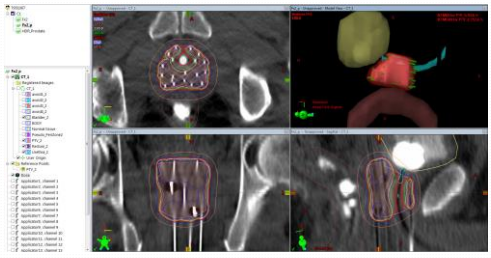








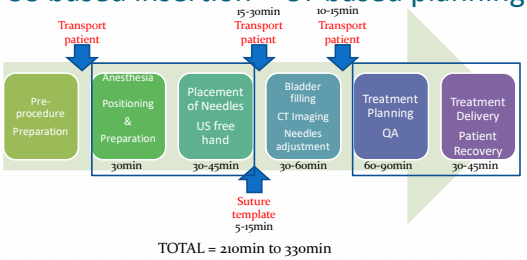




Optimization -Do the best in the least amount of time

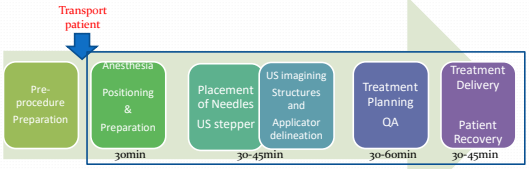
- Analyze the whole workflow and choose the one which minimizes the amount of time while also minimizing uncertainty and errors and maximizing the quality of the treatment.

US based insertion + CT based planning



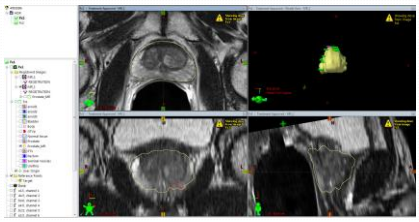
TOTAL = 210min to 330min

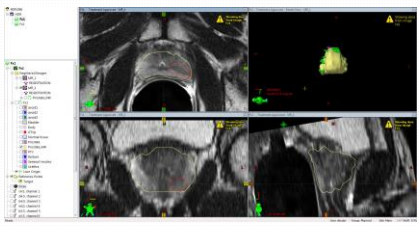
US based insertion and planning

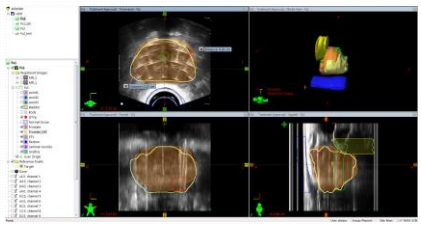


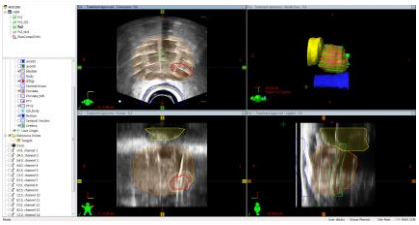
TOTAL = 100min to 170min

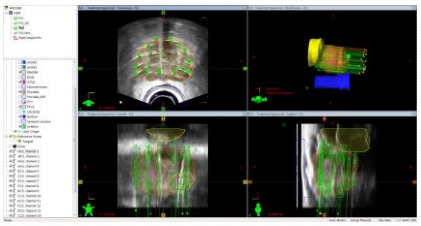
US based insertion and planning MR assisted

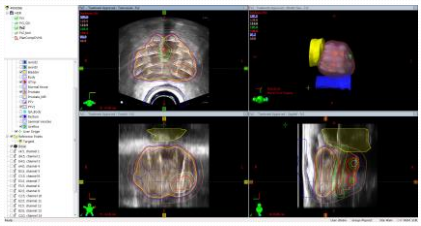












What matters most for patient: experience and outcome

- social needs
- spiritual needs
- practical needs
- daily living needs
- patient-clinician communication
- family-related needs
- physical needs
- psychological emotional needs
- interpersonal/intimacy needs and
- health system/Information needs.

Patients' informational needs while undergoing brachytherapy for cervical cancer:

- Four themes with sub-themes were identified:
  - informational needs,
  - patient disposition towards treatment,
  - psychological experience and
  - physical experience.
- The informational needs included: providing patients with disease- and treatment-related information in their home language; adequate information concerning possible side-effects, sexual intercourse and pre-treatment preparation; and providing patients with informative material as standard procedure.

Review article

The experiences of women receiving brachytherapy for cervical cancer: A systematic literature review

P. Humphrey [a,*], C. Bennett [b], F. Cramp [b]

[a] Bristol Cancer Institute, Bristol Haematology and Oncology Centre, Horfield Road, Bristol, BS2 8ED, UK
[b] Faculty of Health and Applied Sciences, Glenside Campus, University of the West of England, Blackberry Hill, Bristol, BS16 1DD, UK

- Nineteen studies were included for data extraction/synthesis. Twelve studies focused on psychological issues, seven on pharmacological aspects of women's experiences. Themes of anxiety, distress, pain, informational needs and non-pharmacological interventions were found.
- Nine out of ten psychological studies described *brachytherapy as a distressing experience causing anxiety and distress for most women*.
- To improve women's experiences there needs to be better pain management, patient information and the development of non-pharmacological interventions.
- Future recommendations are to *develop clinical support guidelines, audit the quality of services* and *develop effective interventions* to improve women's experiences of brachytherapy for locally advanced cervical cancer.

- Studies show that men diagnosed with prostate cancer *actively seek information* to help them decide.
- They are interested in three key types of knowledge:
  - medical information (to learn about their cancer and treatment options),
  - lived-experience information (to learn from other patients who had faced a similar decision), and
  - medical administrative information (to learn about the logistics of their care and the experience of their physicians).
- They consult a variety of sources such as health care providers, other patients, family members, friends, support groups, decision aids, patient education materials, and the Internet.
- Men with prostate cancer *emphasize the importance of getting comfortable with their treatment choices*. Having a chance to confirm their health care provider's recommendations helps them with this. So does having the freedom to be involved in the decision-making process according to their own personal preferences. Men also said they particularly want information that is relevant and personalized to their specific disease status and treatment options.

A possible solution:

Interprofessional collaboration (IPC)

multiple health workers from different professional backgrounds work together with patients to deliver the highest quality of care. IPC can improve communication and knowledge sharing between collaborating professionals and can lead to an increase in efficient patient care. In the radiation therapy department, radiation oncologists, nurses, medical physicists, and radiation therapists are the key professionals involved in the multidisciplinary care team.

THANK YOU!

All slides and images are available by request

adtodor@vcu.edu