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ACR Accreditation for Utah Valley Hospital's Radiation Oncology Center

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ACR ACCREDITATION FOR UTAH VALLEY HOSPITAL'S RADIATION ONCOLOGY CENTER

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Abstract

Becoming an accredited clinic through the American College of Radiology (ACR) and their Radiation Oncology Practice Accreditation (ROPA) program will provide third-party evaluation of patient care to ensure the best treatment possible for patients.

Talk of getting ACR accreditation has occurred in the past for Utah Valley Hospital/American Fork Hospital, but at the time it was seen as something that did not provide sufficient value vs. the cost. The recent One Intermountain restructuring is intended to unify all of the Intermountain Healthcare radiation oncology centers in Utah so the Radiation Oncology Director has set the goal that all Intermountain radiation oncology programs will be accredited. Intermountain Medical Center (IMC) and Dixie Regional Medical Center (DRMC) are currently ACR accredited and can be used as model programs.

I started with an in-depth examination of our department's workflow, documentation, and policies in order to determine where improvements to meet ACR accreditation standards could be made. I followed this up by working on implementing some of these improvements throughout the clinic and made sure they become routine and a standard in the department. An analysis of Dixie Regional Medical Center and Intermountain Medical Center's ACR documents was performed to provide a baseline of an accredited-ACR program. Finally, a comprehensive checklist of everything that will need to be changed or implemented was presented in order to provide guidance for the future.

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1) Introduction

Working in a radiation oncology center requires very strict attention to detail and having an extremely robust workflow. When mistakes are made, they can cause a wide variety of problems ranging from the delay in a patient's treatment by a couple of minutes, to death. Using a treatment modality such as radiation requires a certain precision: it can be an ally for treating cancer, or it can be very detrimental. Therefore, having standard quality of care is in the best interest of the patients.

The American College of Radiology (ACR) provides just this: when a radiation oncology center receives Radiation Oncology Practice Accreditation (ROPA), the ACR is providing a third-party, unbiased assessment and peer review of patient care in the clinic.[1] The American College of Radiology's Radiation Oncology Practice Accreditation program ensures the assessment of key features of a department – ranging from staff requirements to radiation treatment planning to quality control to patient-safety policies.[1] The recommendations brought forth by the American College of Radiology uses nationally recognized standards such as the American Association of Physics in Medicine (AAPM) to hold clinics to only the highest quality standards.[1] When a decision could be the difference between life and death, nothing is more important.

There has been talk over the years at Utah Valley Hospital (and the American Fork Hospital satellite) to pursue ACR accreditation. At the time, the value vs. the cost was not seen as beneficial; with multiple cancer centers in the system with patient care as the primary objective, there was no doubt about the excellent standard of care. With the new "One Intermountain" initiative and restructuring, there has been more of an emphasis to standardize

the quality of healthcare throughout the system in Utah. The Radiation Oncology Director for Intermountain has stated that one step towards unification of all the radiation oncology centers in the Intermountain Healthcare system is to pursue American College of Radiology accreditation. Currently, two of the four main radiation oncology centers have had ACR accreditation for the past few years – Dixie Regional Medical Center in St. George, and Intermountain Medical Center in Salt Lake City (as well as their satellites). Both of these facilities can be used as resources towards ACR accreditation and, as such, represent model programs.

The scope of this project is to do an in-depth analysis into ACR practice requirements in combination with the current practices and workflow of Utah Valley Hospital's radiation oncology department (as well as American Fork Hospital, which has the same core staff and the same workflow). The Radiation Oncology Practice Accreditation Program Requirements document, ACR Practice Parameter documents, Dixie Regional Medical Center documents, and Intermountain Medical Center documents will be analyzed and critically assessed and compared to the current practices and standards utilized by Utah Valley Hospital's cancer center. Changes to the department workflow that have been recently implemented in the department prior to the initiation of this ACR analysis, but have been very helpful to the process are assessed and analyzed. Different changes and implementations of policies and workflows made during this initial ACR inspection are discussed with their relation towards the overall goal of meeting Radiation Oncology Practice Accreditation program requirements. Finally, a comprehensive checklist of changes to be made to current deficiencies, how to improve and implement them, and their priority is created in order to provide guidance to Utah Valley Hospital's radiation oncology department.

This clinically-oriented project is extremely beneficial to Utah Valley Hospital's radiation oncology program as it allows currently-employed medical physicists to focus on clinical work and other clinical projects. Additionally, by having a resident not employed by Intermountain doing the analysis, it provides a more honest and unbiased look into Utah Valley Hospital's radiation oncology department's workflow and procedures. Performing this in-depth study and analysis of the department's workflow and practice not only helps prepare for ACR accreditation (which has been approved for the 2020 budget), but it also helps ensure that the standard of care for all patients is kept to the highest standard.

2) Methods and Materials: Document Analysis

2.1) Radiation Oncology Practice Accreditation Program Requirements

The *Radiation Oncology Practice Accreditation Program Requirements* document outlines the entire scope of becoming American College of Radiology accredited.[2] There is information relevant to the application needed, preliminary self-assessment information, checklists for the on-site survey, and more.[2] However, the primary benefit of this document is listing general requirements needed for accreditation. Personnel qualifications, staffing levels, and continuous quality improvement are listed, as well as the core-requirements for accreditation: radiation oncologist and physicist availability, process of radiation therapy, general brachytherapy requirements, policy and procedures, physics quality control, and other recommendations.[2] Analyzing this document will be a crucial part of the initial analysis of the steps required to prepare Utah Valley Hospital for accreditation.

2.2) Practice Parameters

The next step in the analysis is reviewing the ACR Practice Parameter documentation. These documents are at their core a much more in-depth look at each of the other requirements of the radiation therapy process. The Practice Parameter documents are highly specialized and specific to different aspects including: Radiation Oncology, Intensity Modulated Radiation Therapy, High-Dose-Rate Brachytherapy, Low-Dose-Rate Brachytherapy, and High-Dose-Rate Brachytherapy Physics.[3-7] Reviewing each of these documents and determining where Utah Valley Hospital could be more compliant with the guidelines and recommendations listed in the Practice Parameters will provide even more guidance into into the next steps required for American College of Radiology accreditation. Being in agreement with each section of all

Practice Parameters will ensure an extremely high quality of care for patients, as well as ACR compliance.

2.3) Additional ACR Documents

Additional ACR documents obtained from their website provided useful information, e.g. *Radiation Oncology Practice Accreditation FAQ for Medical Physicists* and *ACR ROPA Brochure* (which includes frequent deficiencies).[8-9] Although not nearly as detailed as other documents, these more generalized documents help to shine light on some of the more important topics required for compliance. Additionally, analyzing Utah Valley Hospital's radiation oncology center compared to the frequent deficiencies will help with an initial evaluation of the clinic – the more of these frequent deficiencies Utah Valley Hospital is compliant with, the easier accreditation should be to attain. This frequent deficiencies section in the *ACR ROPA Brochure* will also help to determine whether Utah Valley Hospital's radiation oncology center is already providing a high quality of care to patients.

2.4) Intermountain Compliance Documents

Due to Dixie Regional Medical Center and Intermountain Medical Center's radiation oncology practices being American College of Radiology accredited already, they are valuable resources to be used as ideal practices. Having already gone through the accreditation process, the centers are extremely knowledgeable about some of the requirements, policies, and procedures that ACR surveyors emphasize during inspections. By comprehensively analyzing these American College of Radiology Radiation Oncology Practice Accreditation reports (including both initial accreditation and follow-up accreditation), we will have a good idea of some of the more common deficiencies in Intermountain facilities, as well as what ACR tends to

focus on and where in our workflow we should be prioritizing our efforts. By analyzing these more important changes in the eyes of the American College of Radiology, it also shows where they believe facilities should focus on making improvements for the benefit of the patient. Having a different set of views and an outside perspective shaped by different experiences is always something important and should not be taken for granted.

3) Results

3.1) ACR Document Analysis

3.1.1) Radiation Oncology Practice Accreditation Program Requirements

An in-depth analysis and review of all of the relevant American College of Radiology documentation (as described in Methods and Materials) was performed. The first preliminary analysis was done using the *Radiation Oncology Practice Accreditation Program Requirements* document to provide a general baseline overview of Utah Valley Hospital's radiation oncology center compared to ACR.

Staffing levels of Utah Valley Hospital and American Fork Hospital's radiation oncology centers were analyzed and compared to American College of Radiology classification – in 2017, Utah Valley Hospital's radiation oncology center treated 280 patients and is hospital based, placing Utah Valley Hospital's program in the H2 level (Hospital-based, 201-599 patients); American Fork Hospital's radiation oncology center treated 155 patients in 2017, placing it in the H3 level (Hospital-based, 200 or fewer patients). A comparison of Utah Valley Hospital and American Fork Hospital's cancer centers with ACR-recommended stratum levels can be seen in Table 1.

Table 1: Staffing Levels Compared to ROPA Program Requirements

Ratio	Hospital	Classification	Actual	Ideal
New patients (280+155)/FTE radiation oncologist (1.6)	Both	H2	272	217
New patients (280+155)/FTE physicist (2)	Both	H2	217.5	244
New patients (280+155)/FTE dosimetrist (1.6)	Both	H2	272	254
New patients (280)/FTE radiation therapists (3)	UVH	H2	93	77
New patients (155)/FTE radiation therapists (2)	AFH	H3	77.5	62
FTE radiation therapist (3)/treatment units (1)	UVH	H2	3.0	3.0
FTE radiation therapist (2)/treatment units (1)	AFH	H3	2.0	2.6
New patients (280)/treatment units (1)	UVH	H2	280	221
New patients (155)/treatment units (1)	AFH	H3	155	139

According to this comparison, the radiation oncologists, dosimetrists, and radiation therapists (for Utah Valley and American Fork) were slightly below these recommended national stratum levels. Additionally, the number of treatment units (at Utah Valley Hospital and American Fork Hospital) were also below the recommended national stratum levels.

Qualification of staff was analyzed as compared to those recommended by the American College of Radiology (Table 2).

Table 2: Staff Qualifications Compared to ROPA Program Requirements

Medical Director:	**Conditions met?**
Radiation Oncologist	X
Responsible for oversight of department, including policies, procedures, and personnel	X
Responsible for instituting and supervising the continuing quality improvement (CQI) program through direct or delegated leadership	X
Radiation Oncologist:	
Certification in Radiology by ABR with confining practice to radiation oncology, or certification in radiation oncology/therapeutic radiology by ABR, the American Osteopathic Board of Radiology, the RCPSC, or he College des Medecins du Quebec. Rad oncs with time-limited certificates of board certification are to be enrolled in the certifying board's maintenance of certification program and satisfactorily renew certification, or those with non-time-limited certificates are strongly encouraged to voluntarily participate in maintenance of certification program.	X
Qualified Medical Physicist:	
Strongly recommends the individual is certified in the appropriate subfield (Therapeutic Medical Physics) by ABR, CCPM, or ABMP	X
Radiation Therapists/Sim Staff:	
Therapists and sim staff should fulfill state licensing requirements.	X
Therapists should be certified in radiation therapy by AART, or be eligible for certification; Sim staff should be certified by AART in radiation therapy or diagnostic imaging, or eligible.	X
Dosimetrist:	
Dosimetrists should fulfill state licensing requirements.	X
Should be certified in medical dosimetry by the MDCB, or be eligible.	X
Patient Support Staff:	
Those involved in nursing care of patients should have appropriate nursing credentials and appropriate experience in the care of radiation therapy patients. Oncology nursing certification is encouraged.	X
Access to qualified nutritionists or social workers should be in place.	X

The next section analyzed in the ROPA Program Requirements document was the Continuous Quality Improvement and Quality Assurance Committee. The American College of Radiology requires an official Continuous Quality Improvement/Quality Assurance Committee that discusses things such as patient chart review, morbidity and mortality, focus studies, physics quality assurance, and more. Because of the environment at Utah Valley Hospital, staff is always communicating during the workday, leading to many of these issues being discussed as they occur. However, official documentation of these issues will be required. A more official analysis including comments on how to solve the deficiencies compared to ACR standards can be seen in Table 3.

Table 3: Continuous Quality Improvement Compared to ROPA Program Requirements

Continuous Quality Improvement:	**Conditions Met?**
Chart review (cases with variation from prescription >10% of dose, new modalities or techniques, and charts in which an incident report is filed).	X
Morbidity/mortality review.	Will add to Chart Rounds
Review of internal outcome studies (patient side effects, quality of life, etc.).	Discussed in passing, not formally documented
Focus studies (Facility Practice Improvement - department improvement activities/projects that are measured).	Discussed in passing, not formally documented
Individual physician/physicist peer review.	Chart rounds for physicians
Patient satisfaction surveys.	X
Port film/image review.	Done, but not discussed
Chart rounds.	X
Quality Assurance Committee:	
Review/follow up on: Medical events Machine down time Percentage of weekly chart checks/EOT checks Treatment complications Department clinical statistics: morbidity/mortality, outcome/focus study Patient satisfaction surveys MD and Physicist peer review Medical physicist QA reports Establishing and reviewing clinical processes Discussing process & clinical errors, establishing cause, effect, & solution	Do not have QA committee yet. Will rope in the physicians, physicists, dosimetrists, and nurses. Will most likely have meetings on Wednesdays and combine with chart rounds. Will add in Continuous Quality Improvement to this QA Committee as well.

Following Continuous Quality Improvement, an analysis of radiation oncologist and medical physicist availability was determined. An evaluation of oncologist and physicist availability as compared to *Radiation Oncology Practice Accreditation Program Requirements* can be seen in Table 4.

Table 4: Oncologist and Physicist Compared to ROPA Program Requirements

Radiation Oncologist Availability:	**Conditions met?**
Available for direct care and quality review.	X
Should be on the premises whenever radiation treatments are being delivered.	Depends on interpretation: Is being at the satellite sufficient for on premises?
Rad onc/facility/support staff should be available to initiate urgent treatment within medically appropriate response time on 24-hour basis, or refer to one that can.	X
When unavailable, rad onc is responsible for arranging appropriate coverage.	X
Medical Physicist Availability:	
Must be available when necessary for consultation with rad onc and to provide advice/direction to technical staff when treatments are being planned/patients being treated.	X
When not on site for routine treatment, clinical needs should be met using documented procedures.	X
Authority to perform specific clinical physics duties must be established by the physicist for each member of the physics staff in accordance with their competence (rad onc should be informed).	X

Because there are two physicians for the two sites (Utah Valley and American Fork), there is sometimes not a physician present at each location during treatment. This is something that is open to interpretation – whether or not being at the satellite or main clinic counts as being on the premises for the other location. Additionally, there are usually medical oncologists present, as well as other physicians (since these are hospital based treatment centers). There has been a rather large amount of discussion on this, ranging from ACR to general guidelines for radiation oncology clinics as well. Another perspective on this topic is that both Dixie Regional Medical

Center and Intermountain Medical Center's radiation oncology clinics have ACR accreditation, yet both operate with very similar physician coverage in the clinic.

The next set of requirements in the analysis was the process of radiation therapy, with the first part geared towards physician workflow – consultation, history, physical, patient evaluation, treatment summary, and follow-ups. A comparison of the physician workflow compared to American College of Radiology requirements can be seen in Table 5.

Table 5: Physician Workflow Compared to ROPA Program Requirements

Consultation/History and Physical:	**Conditions met?**
Overall stage grouping and TNM classification of tumor in consult note and staging sheet.	X
Performance classification (Karnofsky or ECOG).	X
Chemotherapy information (drugs, schedule, etc.) if applicable.	X
Documentation of physical exam done by a rad onc.	X
Patient Evaluation:	
Patient evaluation (and when appropriate, physical evaluation) should be performed weekly and more often when warranted during treatment by rad onc.	X
Treatment Summary:	
After a course of treatment is completed, rad onc should document a summary of treatment delivered, including site treated, modality used, dose/fx, total dose, elapsed time, treatment response (if applicable), relevant side effects (if applicable), and other observations.	X
Follow-Up:	
A follow-up plan should be documented at completion of treatment in the patient chart.	X
Rad onc should see patients at regular, on-going intervals.	X
If direct follow-up not possible/practical (due to medical condition, patient choice, unreasonable travel), rad onc should review follow-up documentation provided by other pertinent medical providers.	X

Following physician workflow, radiation therapy requirements, as they pertain to treatment planning workflow (starting with the prescription and ending with treatment planning) was analyzed. One of the two requirements with which our clinic is not compliant is taking photos of the patient setup during simulation (something that is currently only done for complex

setups). Additionally, although physics usually signs off on the plan prior to treatment, that is not always the case. To rectify this, there has been discussion of having the physicists do treatment approval via signature (instead of signing the plan printout in the current workflow), something that is currently done by dosimetrists. This would ensure that physics checks the plan before the initiation of treatment, as treatment approval is required before a patient can be treated. A summary of the rest of the requirements can be seen in Table 6.

Table 6: Patient Treatment Planning Workflow Compared to ROPA Program Requirements

Prescription:	**Conditions met?**
Volume (site) to be treated.	X
Description of ports (AP, PA, lateral, etc.)	X
Radiation modality.	X
Dose per fraction, fractions per day, per week, and total.	X
Total tumor dose.	X
Prescription point/isodose.	X
Simulation of Treatment:	
Sim order signed/dated by rad onc	X
Sim order includes treatment site, treatment position, immobilization devices, and contrast (if applicable).	X
Simulation and treatment photos include patient's name, date of photo/sim, and treatment set-up information (immob, position, tattoos, etc.).	Do not always take photos during Sim.
Treatment Planning:	
Documentation of delivered doses to volumes of target/non-target tissues in the form of DVHs and representative isodose treatment diagrams in the patient's electronic record.	X
Prescription and isodose plan MUST be signed/electronically approved by rad onc and medical physicist prior to initiation of radiation therapy.	Currently physics does not always sign off before.
Patient specific goals/requirements of the treatment plan (including specific dose constraints for the target(s) and nearby critical structure(s)) should be documented.	X

The last part of the process of radiation therapy requirements is a general overview of the process of brachytherapy; the status of compliancy with these requirements is shown in Table 7 below.

Table 7: General Brachytherapy Workflow Compared to ROPA Program Requirements

General Brachytherapy:	Conditions met?
Written directive signed and dated by physician prior to procedure.	X
Complete documentation in patient record.	X
Written directive for each procedure should include treatment site, isotope, number of sources, planned dose to designated points.	X
Written summary of treatment delivery after brachytherapy is completed, which includes a total dose of brachytherapy + external beam, time of source insertion/removal, and documentation of radiation safety survey of patient/room.	X
Policy requiring two forms of patient ID, as well as verification of treatment parameters prior to each treatment must be documented.	X

Policies and procedures were the next section of the report analyzed for compliancy. While Utah Valley Hospital's radiation oncology center has many policies and procedures in place, not all of them are written down. This is due in part to the facility being fairly small (nowhere near the size of university radiation oncology centers), the staff working very well as a team, and the fact there is not a large turnover of staff. However, to be compliant with the American College of Radiology and receive accreditation, these policies and procedures will need to be written down formally. An evaluation of compliancy with ACR's required formal policies and procedures is shown in Table 8.

Table 8: Policies and Procedures Compared to ROPA Program Requirements

Policies and Procedures:	Conditions met?
Timeout policy for simulation and treatment.	X
Administration of contrast (if applicable).	X
Image guidance and port film policy: set of patient positioning or target localization images should be taken at least weekly for any new fields. The rad onc should review these prior to the next treatment.	Have one, but not official/written
Disaster Plan: Written disasters plan based on assessment of contingencies appropriate for local practice environment.	Follow Intermountain policies, not written
Infection control.	Follow Intermountain policies, not written
Radiation safety.	Follow state regulations, but do not have it written officially

The penultimate section of the ACR ROPA requirements entails physics quality control, detailing many different aspects of physics quality assurance (seen in Table 9).

Table 9: Physics Quality Control Compared to ROPA Program Requirements

Physics Quality Control:	**Conditions met?**
Formal physics policy and procedure manual in place and reviewed on annual basis.	X
Documented, formal TPS QA plan, including periodic confirmation of treatment planning system consistency.	Will implement TPS QA compliant with MPPG
Patient-specific QA for IMRT, SBRT, SRS, etc. should be documented and approved prior to initiation of treatment (recommended established standard for QA and set a pass/fail criteria).	Have to document + set established procedures officially
Hardware and software updates need to be documented.	
Thermometer/barometer comparison/calibration must be performed/documented.	X
At completion of treatment, qualified medical physicist shall review the entire chart to affirm fulfillment of the initial and/or revised prescription dose. The review should be documented by the physicist, initialed/signed and dated **no later than one week** after the end of treatment.	Once updated chart checks occur, will have place to sign/initial

Although there is currently a Treatment Planning System (TPS) QA program, it is a more simplified one; therefore, a TPS QA in compliance with the Medical Physics Practice Guidelines (MPPG) will be implemented. Additionally, even though there are departmental policies made by physics for patient-specific quality assurance (including IMRT, SBRT, and HDR), it is not officially documented. Chart checks are done on a weekly basis, with the final end-of-treatment (EOT) review documented in a spreadsheet; however, this sheet has no fields for initials or dates. There has long been discussion with physics about updating and overhauling the chart checks, and now is the perfect time for that change in order to become ACR compliant.

The final section of the *Radiation Oncology Practice Accreditation Program Requirements* is other, miscellaneous suggestions and recommendations. Some of the suggestions include the use of heterogeneity corrections and their documentation during

commissioning. Additionally, AAPM TG-66 should be followed and implemented. Utah Valley Hospital's radiation oncology practice currently follows TG-66 at quarterly intervals instead of the monthly-recommended interval. The rest of the other recommendations provided by the American College of Radiology can be seen in Table 10.

Table 10: Other Recommendations Compared to ROPA Program Requirements

Other Recommendations:	**Conditions met?**
Prescription must be linked to an anatomical site and not just state PTV1, PTV2, etc. The point/volume that is being prescribed, for example, 95% volume, should be included.	X
Total cumulative dose should be entered in prescription to indicate dose beyond they cannot treat.	X
IMRT, SRS, SBRT, etc. treatments should have heterogeneity correction used in TPS and its commissioning documented in a written report.	Used, but no formal report
AAPM TG-66 recommends annual evaluation of electron density to CT number conversion to be consistent with commissioning and manufacturer recommendations. There should be evidence of this implementation.	Currently doing CT QA Quarterly, not monthly
Independent MU/backup calculation check program should be available.	X
During treatment set-ups and treatments, there should be two therapists per treatment machine.	X
All staff must comply with their appropriate licensure and/or certification requirements.	X

Overall, after this preliminary analysis, Utah Valley Hospital's radiation oncology center was found to be in compliance with the vast majority of American College of Radiology standards. Although some deficiencies will need to be addressed, it was reassuring that there were no major problems that could significantly disrupt current clinical workflow.

3.1.2) Practice Parameters

The next step of the analysis was to review the ACR Practice Parameters. These documents were a lot more focused on certain aspects of the different processes of radiation therapy and workflow, as well as different modalities. Table 11 shows the deficiencies from each ACR Practice Parameter, and comments on those deficiencies.

Table 11: Analysis of Practice Parameters and Deficiencies

Practice Parameter	Section/Deficiency	Comments
ACR-ASTRO Practice Parameter for Radiation Oncology	An in vivo dosimetry system/capability must be available to patients.[3]	Have not done in vivo dosimetry for a while at Utah Valley Hospital, but can order as needed.
ACR-ASTRO Practice Parameter for Radiation Oncology	A sample of patient charts must be reviewed as a component of the Continuing Quality Improvement process.[3]	Currently doing this as a part of the state's requirement for annual audits, but not performing as comprehensive of a job as the ACR would like. Will start doing patient chart audits during QA/CQI Committee meetings.
ACR Practice Parameter for Intensity Modulated Radiation Therapy (IMRT)	The system's software should be periodically verified for confirming the accuracy of the system-generated dose-volume histograms (DVHs).[4]	We believe that the DVH is working properly (have never had or heard of any issues on any vendor bulletins), to confirm the accuracy would be very intensive. Will do spot-checks by re-calculating plans and comparing.
ACR Practice Parameter for Intensity Modulated Radiation Therapy (IMRT)	MLC test patterns should be done at different collimator and gantry combinations as part of the routine QA process.[4]	No reason for MLCs to function differently based on collimator rotation, but we use same collimator rotation, which does test them against gravity at gantry 270 and 90.
ACR-ABS Practice Parameter for the Performance of Radionuclide-Based High-Dose-Rate Brachytherapy	The systematic approach for applicator and source insertion should include applicator option and insertion techniques.[5]	Currently only have one physician doing implants, so insertion techniques is unnecessary, as this is something that can vary from physician to physician.
ACR-ABS Practice Parameter for the Performance of Radionuclide-Based Low-Dose-Rate Brachytherapy	Informed consent must be obtained and documented.[6]	The patient receives a consent through the operating room for eye plaques (our only LDR procedures) and their care is managed by the eye surgeon - is oncology required to consent in this case?
ACR-AAPM Technical Standard for the Performance of High-Dose-Rate Brachytherapy Physics	The quality management report must be signed by the responsible radiation oncologist.[7]	The physician signs off on the relevant forms (survey, time out/identification, etc.) but not the overall post-treatment HDR report. This is something that could easily be signed by physician in documents.
ACR-AAPM Technical Standard for the Performance of High-Dose-Rate Brachytherapy Physics	Post treatment survey should include the patient, transfer tube(s), and the HDR unit.[7]	The HDR unit is surveyed, as well as a general background (which includes the patient and the transfer guide tubes). If the background were to ever be above normal, further investigation into why would be done.

3.1.3) Additional ACR Documents

The *Radiation Oncology Practice Accreditation FAQ for Medical Physicists* addresses more common questions that tend to occur for American College of Radiology accreditation. Some of these answers provide clarification on some of the topics that come up in physics that might not be suitable to place in any specific Practice Parameter. The answers to questions in this document with which Utah Valley Hospital's radiation oncology center is not compliant with are listed with comments and ways to remedy those in Table 12.

Table 12: ROPA Medical Physics FAQ Deficiencies

Deficiency	Comments
Documentation should show evidence of AAPM TG-142 compliance for treatment machine imaging QA.[8]	We feel that the MPPG is more relevant than TG-142 for OBI QA.
Periodic imaging QA should follow TG-66.[8]	This has been addressed already, but will begin doing monthly CT QA as opposed to quarterly.
Multi-physicist sites should have on-going peer review for physics with a policy in place (including annual performance documentation, as well as QA review).[8]	Will begin implementing this into QA/CQI Committee meetings.
Physics should have a policy stating high dose (>300 cGy/fraction) treatments are checked prior to treatment.[8]	Once physics begins doing Treatment Approval, it will be in policy that every plan must be checked prior to treatment.

The next analysis was performed using the frequent deficiencies section in the *ACR ROPA Brochure.* As a side note, this analysis – as well as all others performed after this – was performed after there had been some changes to Utah Valley Hospital's radiation oncology's workflow and procedures (made with ACR accreditation in mind); these changes will be discussed in greater detail later. The frequent deficiencies list is a good place to start when analyzing what it will take to get a program accredited by the American College of Radiology: if you are compliant with most of the deficiencies, you will be in good shape. Table 13 lists all of

the frequent deficiencies, along with Utah Valley Hospital's radiation oncology program's compliancy with each deficiency.

Table 13: Compliancy with ACR Accreditation Frequent Deficiencies

Deficiency	Compliant?	Comments
Insufficient information in consult note	Yes (According to physician after reading Practice Parameter on Communication; will verify during patient analysis)	
Incomplete patient history/physical examination	Yes (According to physician after reading Practice Parameter on Communication; will verify during patient analysis)	
Incomplete treatment prescriptions	Yes	
Lack of defined goals and requirements of treatment plan by rad onc	Yes	
No formal TPS QA plan	In progress	
Lack of DVHs	Yes	
Lack of proper treatment QA prior to patient treatment (i.e. no IMRT QA)	Yes	
No written directive for brachytherapy procedures	Yes	
Insufficient rad onc coverage during patient treatment	Somewhat	Depends on interpretation.
Lack of port film verification	Yes	
Lack of documented weekly patient visits	Yes	
No documented patient follow-up plan	Yes	
No formal QA and improvement program documented	Somewhat	Have it documented in CQI, but need to be more elaborate
No physician or physicist peer-review documented	Somewhat	No formal Physics Peer-Review yet
End-of-treatment physics check not performed within a week	Yes	

3.2) Intermountain Report Analysis

Using Dixie Regional Medical Center and Intermountain Medical Center's radiation oncology centers as resources for preparing for ACR accreditation has been an extremely valuable resource. Being able to analyze their American College of Radiology accreditation reports (both initial and follow-up accreditations) has provided a vast amount of information allowing us to determine the similarities and differences between the different radiation oncology departments, as well as where we should be placing our emphasis. Some of the deficiencies noted for Dixie Regional Medical Center and Intermountain Medical Center, and how they pertain to Utah Valley Hospital, can be seen in Table 14.

Table 14: UVH Compared to DRMC & IMC ACR Review

Hospital	Deficiency	UVH Comments
DRMC IMC	Patient ports should be taken for any new field and at least weekly; these should be reviewed by the physician before the next treatment	Compliant
DRMC IMC	EOT document done by physicist no later than one week after completion of treatment	Compliant
DRMC IMC	All patient field setups should be documented, including a photo	Deficient (only complex setups are photographed currently)
DRMC	The oncologist should provide specific simulation instructions	Compliant
DRMC	All treatment calculations must be verified by an independent system, which should be checked by a physicist before the first treatment (<5 fx) or the third treatment (>5 fx)	Primarily Compliant (will be completely once physics does Treatment Approval)
DRMC	There should be documentation of heterogeneity corrections	Deficient (no formal document)
DRMC	MLC leaf speed for IMRT should be checked	Included in Portal Dosimetry
IMC	Treatments per week should follow the amount listed in the prescription	Compliant
DRMC IMC	Thermometer/Barometer calibration should be done on an annual basis	Compliant
IMC	OBI should be checked daily	Compliant

3.3) Preliminary Self-Assessment Tool Kit

The American College of Radiology provides an *ACR Accreditation Facility Tool Kit*, which is a self-assessment for radiation oncology clinics prior to going through the accreditation process.[10] An analysis of two patients (prostate external beam + brachytherapy boost treated by one physician and one tangents breast treated by the other physician) was performed using this tool kit. This was a rigorous analysis: if something was missing from a patient's chart that was in their folder that hadn't been uploaded yet, it was counted as deficient. The analysis from both of these tool kits can be found in Appendix A. The results from these tool kits is incorporated into later documents for a more comprehensive review of Utah Valley Hospital's radiation oncology department in terms of American College of Radiology requirements.

3.4) Mock ROPA Report

Based on the reports from the American College of Radiology for Dixie Regional Medical Center and Intermountain Medical Center, a mock ROPA report was created for Utah Valley Hospital's radiation oncology center. This report is comprehensive, and is meant to be similar to an American College of Radiology accreditation inspection report. This report, coupled with all the prior assessments, will be a primary documentation detailing all of the changes to be made to Utah Valley Hospital's program. This report in its entirety can be found in Appendix B, with results summarized in Figure 1 on the next page. Although the report states the accreditation outcome is "defer", this is due to being extremely strict, as well as not knowing how ACR inspectors grant accreditation. This is something that will be brought up in the discussion.

Figure 1: Utah Valley Hospital ACR Mock ROPA Report Summary

Radiation Oncology Practice Accreditation (ROPA) Report

Site(s) Information:

Site: 1
Utah Valley Hospital

Site: 2
American Fork Hospital

ACR Program Requirements

Section 1. Staffing

Staffing Levels	See Stratum Table Comments
Staff Qualifications	Acceptable
Radiation Oncologist Availability	See Section
Medical Physicist Availability	Acceptable

Section 2A. Radiation Oncologist(s) Data Collection

History and Physical/Consultation	See Section
Treatment Section	See Section
Patient Evaluation	Compliant
Treatment Summary	Compliant
Follow-Up	See Section

Section 2B. Medical Physicist(s) Data Collection

Chart and Physics Documentation	See Section
Simulation	Acceptable
Treatment Planning	See Section
Modalities	See Section

Section 3. Physics Quality Control Program

Instrumentation	Acceptable
Simulation/Treatment Machine/Quality Assurance	See Section
Treatment Planning	Acceptable
General Quality Assurance	See Section

Section 4. Policy and Procedures

Practice's Policy and Procedures	See Section

Section 5. Continuous Quality Improvement

Practice's Continuous Quality Improvement	See Section

Overall Accreditation Outcome: Defer

3.5) ACR Deficiencies Checklist

Based upon American College of Radiology compliance documents analyzed, Dixie Regional Medical Center and Intermountain Medical Center ACR review documentations, and self-assessment, a comprehensive list of deficiencies at this current time was created. This list is an attempt to outline all of the changes that must be made, and suggests certain ways to implement them. All of these changes/deficiencies are ranked by priority in order to provide guidance as to where to start: priority is a combination of what is deemed important in the eyes of the American College of Radiology, as well as what I feel is of the most benefit to the patients and the radiation oncology practice. The main purpose of this checklist is to function as a guide for the future: what changes should be implemented, how to go about implementing them, and how to prioritize those changes and deficiencies. This comprehensive checklist is provided in Table 15.

3.6) Changes Made

Prior to the American College of Radiology analysis, there were some changes made to the department to improve workflow. The Care Paths workspace was implemented in order to ensure nothing slipped between the cracks. Prior to Care Paths, there was an excessive amount of handing off of tasks and tracking down staff members. By implementing Care Paths, not only did it help with workflow, it also ensured every staff member knew what they had to be doing and when. An addition to Care Paths was also the implementation of using Prescribe Treatment instead of physical, paper prescription cards. By utilizing both of these workspaces, it ensures that a prescription MUST be entered by a physician before a plan can even be started (something that could happen before if the physician told the dosimetrist what they wanted by word of mouth). Additionally, it also ensures that the prescription is not misread when planning.

Table 15: Comprehensive Deficiencies Checklist

Topic	Deficiency	Priority	Comments
Quality Assurance Committee	No formal Physics Peer Review implemented; very simple/brief M&M, focus studies, & internal outcome studies. Currently no sample of patient charts gone over.	1	Implement Physics Peer-Review. More in-depth M&M, focus studies, and internal outcome studies. Review a patient weekly.
Policy and Procedures	No formal written policy for IGRT/Port films, disaster plan, infection control, or radiation safety	1	Use St. George as a baseline - could use this as opportunity for more Intermountain Standardization
Consultation/ History/ Summary/ Follow-up/Etc.	Not everything is always included (i.e. staging and follow-up note not present for breast patient)	2	A physician document in Encounters could help take care of this & guide physicians to everything; could also update consult form
Physics QA - CT QA	TG-66 must be followed	2	Currently do CT QA to the standard of TG-66 ~quarterly instead of the required monthly
Brachytherapy - Consent	"Informed consent must be obtained and documented" - for eye plaques, patient gets consent outside of department	2	Is the out-of-department consent acceptable to use
Chart/Physics Documentation - Photos	Patient set-up photo not included all the time	2	Take set-up photo(s) at Sim
High-Dose Treatment Policy	No policy for >300 cGy/fx treatments	3	Will be taken care of once physics does Treatment Approval, ensuring all plans are looked at by physics before treatment
Physics QA - Commissioning Report	Commissioning Report should be formally written	3	Report should include beam data validation, as well as heterogeneity and IMRT/VMAT validation
Policy and Procedures - QMP	The physics QMP should be updated for CT Sim QA; should include MU calculation & chart check policies	3	
Physics QA - Machine QA	TG-142 should be followed (weekly MLC tests/travel speed, monthly profile constancy, monthly OBI)	4	Could argue that MPPG is more relevant than TG-142; ensure MPPG compliance
Physics QA - MLC	Method to calculate MLC leaf speed should be included, as well as adding in collimator rotation for picket fence tests	5	
Physics QA - DVH	Confirm accuracy of DVH	5	
Brachytherapy - Process	The systematic approach for applicator and source insertion should include applicator option and insertion techniques	5	Create a document with applicator options and an insertion techniques policy?

Reading a handwritten dose prescription can be difficult, and there have been instances where a number was misread or a decimal was missed. Therefore, these two implementations are not only helpful to having a proper ACR-compliant workflow, but they make the workflow much safer for the patient.

During the beginning of analysis of American College of Radiology documents, there were some very helpful changes implemented. For example, SBRT pre-treatment, patient-specific quality assurance was revised. Due to the simplicity of independent calculation checks, lung SBRT plans tend to be in significant disagreement, often in the 20% range. By revising the SBRT QA program and implementing pre-treatment phantom dose verifications for each patient (and utilizing Care Paths to make sure they are performed), there is a much better feeling about performing SBRT's – having that extra measurement provides immense comfort in knowing that nothing is going wrong with each patient's plan.

Another change to the workflow that occurred was the addition of physics contour review tasks in addition to Encounters for plan reviews and chart checks. This change is a needed step before physics signing off on Treatment Approval. By having contour review tasks, physics is able to create a new plan check from a saved template in Encounters, check the patient clinical data such as pathology, consult, and radiology (something that was not emphasized as much in the past) with ease due to the nature of Encounters. After the clinical data is checked, the contours can be checked while the dosimetrists work on the plan. This allows physics to familiarize themselves with the patient before it is time for the plan check. When it comes time for the plan check, physics can save time by already doing most of the clinical review, and can focus all their attention on the plan. This will help immensely when physics does Treatment Approval, and will save time.

One of the biggest changes implemented has been the start of the Continuous Quality Improvement Committee. In addition to Chart Rounds on Wednesday mornings, the Continuous Quality Improvement Committee meets, and is composed of physicians, dosimetrists, physicists, physics residents, nurses and radiation therapists. Although it is still in early adoption and needs some more details for certain aspects (physics QA, morbidity and mortality, focus studies), it is showing promise and has the backing of the physicians. The minutes document for the Continuous Quality Improvement Committee can be seen below in Figure 2.

Figure 2: Quality Assurance Committee Minutes

Quality Assurance Committee Minutes

Date:

Discussion Topic	Discussed?	Notes:
Chart Rounds/New Patient Review/Physician Peer Review	yes/no	
Medical Events	yes/no	
Morbidity & Mortality	yes/no	
Internal Outcome (side effects, quality of life)	yes/no	
Focus Studies (departmental improvement/new processes)	yes/no	
Patient Satisfaction Surveys	yes/no	
Port/Image review	yes/no	
Machine Down Time	yes/no	
Physics QA	yes/no	

Additionally, the MPPG-compliant Treatment Planning System QA has been revised and is in the process of being implemented by another medical physics resident. This has been a large task, and should be in clinical use sometime in the near future. As for other future changes, the process of physics Treatment Approval has been in the pipeline for a while. Implementing the physics contour review task was the first step of getting physics to sign off on Treatment Approval. The next steps will be taken in the near future.

4) Discussion

Based upon the preliminary analysis, Utah Valley Hospital's radiation oncology center seems to be in very good shape for ACR accreditation. For the most part, the clinic is compliant with the *Radiation Oncology Practice Accreditation Program Requirements* document, which encompasses a large majority of the requirements. The Practice Parameters, although extremely in-depth and focused, contain a lot of information and requirements that Utah Valley Hospital is already compliant with. While these documents took a longer time to analyze than most, picking them apart instilled a sense of accomplishment and relief that Utah Valley Hospital's radiation oncology program is not only up to standard and doing something right – it is doing a lot right.

Comparing Utah Valley Hospital's program to those of Dixie Regional Medical Center and Intermountain Medical Center proved to be very interesting: there were some deficiencies they possessed which seemed ludicrous to us, yet they were compliant with some of our major deficiencies. Although the goal is One Intermountain, this analysis showed that the workflow is still varied and different; however, even though the workflows are different, there is still a high quality of patient care. One of the more interesting points of this analysis was the difference between American College of Radiology accreditors – the "passing rate" for what was and wasn't acceptable for ACR standards seemed to fluctuate. Intermountain Medical Center seemed to have more deficiencies compared to Dixie Regional Medical Center; however, Intermountain Medical Center was granted accreditation, while Dixie Regional Medical Center was deferred. Dixie Regional Medical Center appealed to the ACR, and was granted an almost instantaneous approval of the appeal and accreditation – almost too fast to have been reviewed. Is accreditation more of a pass/fail? Do you have to check every box, or are "the majority" of them enough? Are there specific criteria, or is it more up to the discretion of the surveyor? It

appears that with two centers that have achieved accreditation and follow-up accreditation, nobody appears to have a concrete answer.

5) Conclusion

American College of Radiology accreditation for Utah Valley Hospital's radiation oncology center will be a fantastic stepping-stone for the One Intermountain initiative. ACR accreditation holds centers to a standard of care, and is in line with the goal of One Intermountain. This could also be one of the first steps in standardizing the Intermountain radiation oncology centers: policies and procedures need to be formally written for Utah Valley Hospital, and with policies and procedures already created for Dixie Regional Medical Center and Intermountain Medical Center, it makes perfect sense to try to standardize policies now. Additionally, Utah Valley Hospital's accreditation process could be a great resource for McKay-Dee Hospital's cancer center to get accreditation, which would standardize all of the radiation oncology centers as being ACR-accredited.

Overall, Utah Valley Hospital's radiation oncology center is well on its way towards accreditation. Not only is the cancer center already in a good place after this preliminary analysis, but changes have also been made since then to push Utah Valley Hospital closer towards accreditation. These changes that have been made in combination with processes currently in progress will only help with accreditation. Finally, future changes to be made have been outlined and discussed among physics. The future of Utah Valley's radiation oncology cancer center is bright, with ACR accreditation front and center.

Appendix A: ACR Accreditation Tool Kits

The ACR Accreditation Tool Kits for the prostate patient and breast patient can be found in attachments one and two, respectively, of the supplemental material in ProQuest.

Appendix B: Mock ROPA Report

The Mock ROPA Report can be found in attachment three of the supplemental material in ProQuest.

Works Cited

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3. *ACR–ASTRO Practice Parameter for Radiation Oncology*. The American College of Radiology, 2018, www.acr.org/-/media/acr/files/practice-parameters/radonc.pdf.

4. *ACR Practice Parameter for Intensity Modulated Radiation Therapy (IMRT)*. The American College of Radiology, 2016, www.acr.org/-/media/ACR/Files/Practice-Parameters/IMRT-RO.pdf.

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7. *ACR–AAPM Technical Standard for the Performance of High-Dose-Rate Brachytherapy Physics*. The American College of Radiology, 2015, www.acr.org/-/media/ACR/Files/Practice-Parameters/HDR-BrachyTS.pdf.

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9. *ACR Radiation Oncology Practice Accreditation Program*. The American College of Radiology, www.acraccreditation.org/-/media/ACRAccreditation/Documents/ROPA/ropa_brochure.pdf.

10. *ACR Accreditation Facility Tool Kit*. The American College of Radiology, www.acraccreditation.org/-/media/ACRAccreditation/Documents/ROPA/ACR-Accreditation-Facility-Tool-Kit.pdf.

Curriculum Vitae

Remy Manigold
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EDUCATION

Doctor of Medical Physics
University of Nevada, Las Vegas, 8/2016 - 5/2019

- CAMPEP accredited DMP
- Culminating Doctoral Project: "ACR Accreditation for Utah Valley Hospital's Radiation Oncology Center"
- Residency with Intermountain Healthcare (UNLV Hub and Spoke program)
    - Primary site at Utah Valley Hospital, Provo, UT
    - Satellite site at American Fork Hospital, American Fork, UT
    - Observation at Dixie Regional Medical Center, St. George, UT

Master of Science, Medical Physics
University of Nevada, Las Vegas, 8/2014 - 5/2016

- CAMPEP accredited M.S. in Medical Physics
- Thesis under Matthew Schmidt with Varian Medical Systems: "Creating a Dynamic, Multi-Purpose Correction for Multiple Geometries and Field Sizes to Account for Off-Axis and Asymmetric Backscatter with Varian Portal Dosimetry"

Bachelor of Science, Physics
California Polytechnic State University, San Luis Obispo, 9/2010 - 6/2014

CERTIFICATIONS

- ABR Part 1 (Passed: General and Clinical)
- ABR Part 2 (Anticipated date: 8/2019)

WORK EXPERIENCE & SKILLS

Patient Treatments

- Clinical Planning:
    - ~20 clinical 3D plans treated (breasts, boosts, palliative, etc.)
    - ~25 clinical HDR plans treated (prostate, breast, GYN)
- TrueBeam OBI:
    - kV, CBCT, and MV (with 2.5X) imaging
    - Triggered kV imaging for SBRT: bony anatomy (spine) and fiducial-based (prostate)
- VisionRT Align RT three camera system
    - Transition to open face masks for all cranial patients
    - DIBH for left sided breasts
    - Stability monitoring for SBRT

Quality Assurance

- Conducted initial self-audit for ACR compliance to prepare for accreditation
- Implemented SBRT pre-treatment dose verification QA for all SBRT plans using ion chamber and phantom with CBCT-based alignment
- Responsible for executing comprehensive QA program for Philips Big Bore CT, TrueBeam and Clinac iX:
    - Mechanicals, output, MLC, imaging (MV, kV, CBCT), IMRT QA, Align RT
- Annual QA performance under supervision of ABR certified physicist
- Conducted IROC Houston OSL audit exposure
- Attended weekly Oncology Tumor Board & Radiation Oncology Chart Rounds

Brachytherapy

- HDR program (40+ patients/150+ treatments annually):
    - Delivery with GammaMed Plus and planning using BrachyVision TPS
    - Prostate (monotherapy and boost)
    - Breast (SAVI)
    - GYN (Cylinders, T&R, T&O, Miami Cylinder, Interstitial)
- Developed and deployed Optimization Templates to increase efficiency in prostate planning
- Daily HDR warmup
- HDR source exchange and calibration
- Source receiving, inventory, and leak/wipe tests
- LDR prostate implant observation (VariSeed based pre-plan, pre-loaded needles)
- LDR eye plaque program:
    - Eye Physics pre-plan with final dose calculation in BrachyVision
    - Activity verification of ordered seeds (IsoAid IAI-125)
    - Construction of active plaque
    - TG-43 2D line source calculation spreadsheet
    - Provided OR physics coverage

Software

- ARIA:
    - Integrated Varian environment
    - Prepared and suppoted transition to electronic Prescribe Treatment workspace
    - Familiar with implementing and using Care Paths for clinical scheduling and task management
    - Weekly chart checks using Chart QA
- Eclipse:
    - 3D, electron, IMRT, and VMAT planning
    - Clinical Protocols implementation to provide feedback on dosimetric plan goals
    - AAA and Acuros XB commissioning
    - Portal Dosimetry EPID-based IMRT QA
    - CT, MRI, PET/CT rigid registration
- Velocity:
    - PET/CT deformable Registration
    - Standard and BED-equivalent dose summation
- Excellent excel skills/spreadsheets:
    - Automated photon hand calc spreadsheet
    - TG-51 addendum-based linac calibration
    - TG-43 HDR second check & eye plaque second check update from 1D to 2D formalism

Commissioning

- Varian TrueBeam:
    - Acceptance September 2017
    - First patient treatment February 2018
    - Five photon energies (6X, 6FFF, 10X, 10FFF, 15X) and seven electron energies (6, 9, 12, 15, 18, 20, and 22 MeV)
    - 6 DoF couch
    - 2.5X imaging beam
- Standard Imaging IMSure second check software for TrueBeam (photons and electrons)
- TrueBeam 2.5 to 2.7 upgrade

Hardware

- Varian: TrueBeam, Clinac iX, GammaMed Plus HDR
- Sun Nuclear: 3D Scanning water tank, 125C scanning ion chamber, EDGE diode, ICProfiler array
- Standard Imaging: BeamChecker Plus, Stereotactic Dose Verification Phantom, Exradin A26 and A12 ion chambers, IVB 1000 Well Chamber, MAX-4000 electrometer
- Vision RT: AlignRT
- Philips: Big Bore CT with 4DCT and metal artifact reduction
- Survey meters: pressurized ion chamber, GM, neutron

ADDITIONAL INFORMATION

- **AF Canyon Run Against Cancer**, American Fork, UT, Summer 2017/2018
  Volunteered to help run the marathon, which raises money for cancer patients in the community
- **University of California San Diego**, CA, Summer 2015
  Volunteer work with Dr. Laura Cervino working on a GUI to track fiducials for motion management
- **University of Pittsburgh Medical Center Horizon**, Shenango Valley, PA, Summer 2012
  Shadowed Medical Physicist, Dr. Tony Combine
- **Alvarado Hospital Medical Center**, San Diego, CA, Summer 2009
  Sterile Processing Volunteer, helped set up case carts for surgeries
- **Tennis Special Olympics**, San Diego, CA, Summer 2007/2009
  Volunteered in order to help run the Tennis Special Olympics held in San Diego

ADDITIONAL SKILLS

- Mathworks MATLAB (extensive use throughout the years, from GUIs, plotting, data analysis, etc.)
- Fluent in English and proficient in French