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Appendix 1. Clinical background and experience of the clinicians who participated in this study. * - denotes international training.

Participant Identification	Specialty	Academic Rank	Practice Location	Training Program Location
1.	Orthopaedic Surgery	Associate Professor	Massachusetts	New York
2.	Orthopaedic Surgery	Professor	North Carolina	Washington
3.	Orthopaedic Surgery*	Assistant Professor	Pennsylvania	Canada
4.	Neurosurgery*	Assistant Professor	Wisconsin	Rhode Island
5.	Physiatry	Instructor	Massachusetts	Massachusetts
6.	Radiation Oncology	Associate Professor	Maryland	Maryland
7.	Radiation Oncology	Associate Professor	Massachusetts	Massachusetts
8.	Orthopaedic Surgery	Assistant Professor	Illinois	Utah
9.	Neurosurgery	Assistant Professor	North Carolina	Maryland
10.	Neurosurgery	Associate Professor	New York	Maryland
11.	Orthopaedic Surgery	Professor	Virginia	Ohio
12.	Neurosurgery	Assistant Professor	Massachusetts	Ohio

13.	Neurosurgery	Professor	Maryland	Maryland
14.	Orthopaedic Surgery*	Assistant Professor	Canada	Canada

Appendix 2. Complete list of themes and subthemes with supporting quotes. Themes are identified by Roman numerals (I-X) and subthemes are identified by capital letters subordinated to the theme they fall under.

Theme or Subtheme	Findings	Supporting Text from Transcripts
I. Elements of Disease		
	<p>Disease characteristics serve as the basis to guide treatment recommendations. Specifically, participants cited the following elements as important factors: extent of disease, level of neurologic deficit, spinal stability, ambulatory function, prognosis, specific tumor characteristics, and patient comorbidities.</p>	<p>“Second to that is...extent of disease. If you have single-level disease, it’s certainly a much different decision-making process and surgical plan than somebody who has every level involved with multiple sites.” [6]</p> <p>“sometimes the trend is the most indicative, and that trend could be picked up sometimes more easily than the chart will tell you, with age, extent of disease. If the patient continues to have more and more tumors growing throughout their body, despite maximal medical intervention, if they are trending in a very poor direction, the oncologists usually don’t give us a prognosis” [6]</p> <p>“I’m much more likely to look at their albumin, look at their disease progression, and be more critical of those elements than somebody who comes in with acute paraparesis and a single-level disease.” [8-9]</p> <p>“You’d want to know their primary diagnosis. You wanna know what prior treatment they’ve had, what medical comorbidities they have. Is their spine stable? Is it not stable?” [3]</p> <p>“if someone has really diffuse disease and seems like they—and was very frail, then putting them through a surgery—even if they have neurologic deficits or mechanical instability—may not make sense, whereas patients who are doing very well and have limited disease, we have the—manage aggressively for—with the goal of dural local control.” [Non-Op 1, 2]</p>

		<p>“The medical comorbidities definitely play into it from the standpoint of there are patients who otherwise might benefit from surgery because they have high-grade epidural disease or neurologic deficits, or an unstable spine, but if they have too many medical comorbidities, then they can’t have surgery, so we will manage the patients with radiation and just recognize the limitations of radiation.” [Non Op 1, 3]</p> <p>“I think neurology is a big deal, too, in terms of when not to operate. It’s more rare, I guess, to have someone come in with a longstanding cord-level deficit, paraplegic, but it still happens.” [5]</p> <p>“It’s much easier if you get the patients with neurological trouble. Something we’ve been paying a lot of attention to is impacting providers to send these patients very early, even when they don’t have a problem.”[16]</p> <p>“Is the patient having a problem? What is their problem? Is it pain? Is it neurologic problems, or do they just have spinal cord compression with no symptoms?” [2]</p> <p>“It depends on a number of factors, starting off with the lesion itself. Is it solely a painful bone met, meaning it’s not complicated by either soft tissue, epidural soft tissue, and causing nerve root compression or cord compression? Then, also, is it complicated by any signs of instability?” [Non-Op 2, 2]</p> <p>“...if we knew the outcomes in a disease-specific way, I think it’d be nice for deciding on surgery and recommending surgery, informed consent.” [33]</p> <p>“Somebody with epidural disease is going to respond very well to radiation, probably doesn’t need surgery if they’re mechanically</p>
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		<p>stable. Somebody who's mechanical instable, it might be a core compression, someone that's not gonna respond well to radiation. That's somebody who needs surgery. There's stuff out there, but mostly it's out here, of course, but I think it's always the thought process in the conversation." [12]</p> <p>"Progressive, acute, neurological condition is pushing you towards surgery, and highly unstable signs pushing towards medical." [14]</p> <p>"I think that the outcomes and the actual management really depends with a large respect on it in terms of the specifics of any given case." [27]</p> <p>"The second factor in oncologic, and that's really an indicator of radiation sensitivity. There are certain tumors, like myeloma, lymphoma, that melts away with radiation, and certain things like melanoma or renal cell carcinoma that are much more resistant to radiation, and then those kind of historically radio-resistant tumor sites then—we often will think more about stereotactic radiation to give a higher biologically-equivalent dose in order to try to get around that traditional radio resistance." [Non-Op 1, 2]</p> <p>"Just to summarize, it's a combination of the spine metastatic site specific factors [unintelligible 05:03] having to do with those, whether it's complicated by instability or nerve root or cord compression, and then I guess another complicating factor would be whether it's received prior radiation, 'cause that can actually also factor into your decision-making." [Non-Op 2, 3]</p> <p>"They continue to recur in the spine, but they're stable elsewhere, but you're putting them through a big operation." [7]</p> <p>"Look, there's a chance you may not survive surgery given your pulmonary complications, but you're in significant pain." [4]</p>
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		<p>“If the patient continues to have more and more tumors growing throughout their body, despite maximal medical intervention, if they are trending in a very poor direction, the oncologists usually don’t give us a prognosis.” [6]</p> <p>“Then the patient’s overall prognosis picture, the tumor type, all factors into that, as well.” [Non-Op 2, 3]</p> <p>“if someone has a prognosis that’s measured literally in weeks, then I’m thinking maybe even single fraction radiation is—they’re actually not gonna live long enough to see the benefit of that. That would be rare. Usually, with our poorest-prognosis patients, it’s just affecting what we’re choosing as far as how complicated to be as far as our approach, with the least complicated being a single fraction of radiation, which we choose quite often, honestly, especially in uncomplicated bone mets.” [Non-Op 2, 3-4]</p> <p>“case like that might be they have so much pain from instability they’ve—with a high SINS, and then even though their prognosis is short, you are thinking about a procedure, surgery, or certainly for vertebroplasty if it’s feasible, ‘cause that’s the least invasive, because even though they only have two months to live, it’s really important to their quality of life that that pain get managed. Radiation isn’t gonna do anything for their instability.” [Non-Op 2, 7]</p> <p>“If somebody comes in, hasn’t been out of bed or moved in a week, that your decision-making may be swayed by that.” [6]</p> <p>“If someone hasn’t been out of a chair for three or four months, no matter what you do, if you get them a little neurologic rating upgrade, are they really gonna have a functional difference from that?” [10]</p> <p>“You wanna know what prior treatment they’ve had, what medical</p>
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		comorbidities they have.” [3]
A. Failure of Initial Treatment		
	<p>In the event that first-line treatment is unsuccessful, secondary interventions may have higher complication risks. Surgery is riskier if performed shortly after radiation therapy.</p>	<p>“We see a patient who’s already been manipulated and coming to us sometimes in an extreme situation, and if they’ve been rayed, it’s different. It is more complicated, but I’d also argue for radiation oncologists, if someone spilled a tumor all over the field, and there’s no target anymore, it’s hard for them as well.” [25]</p> <p>“If you have to operate shortly after radiation, especially if it’s conventional radiation, you’re much more likely to have those other complications with infections. If it’s very delayed, then much less so. If the treatment that you proposed failed, it might just be an indicator that the cancer itself is very aggressive and not behaving the way you expect it to behave. Then I think your follow-up therapy might also be not very successful.” [24]</p> <p>“The complications from surgery after radiation are—can be higher [unintelligible 12:43] usually lose a window unless they’re—they just are—have gotten really sick or have other comorbidities or more diffuse disease.” [Non-Op 1, 5]</p> <p>“All that can say, someone that fails radiation and needs to go onto a surgery, the main implications of that are if the tumor has truly progressed despite radiation therapy, if that’s the cause for [unintelligible 22:56] go to surgery, it actually just portends a—it means they have very resistant disease, if it’s that; if it’s due to progression. It’s not always progression.” [Non-Op 2, 8]</p> <p>“Whereas, if you do conventional radiation, and then it fails, and you’re operating, and you’re offering up care afterwards, yes, we still can get those controlled, but it’s riskier and more complicated.” [27]</p> <p>“from some data that’s out there, there’s a suggestion that having—</p>

	<p>doing the surgery afterwards, there's a lot more complications, and all that sort of thing." [Non-Op 2, 8]</p> <p>"The treatments actually depend on each other. If I'm not the radiation oncologist that gets the separation surgery algorithm, or the young surgeon that doesn't understand the capabilities of that combinatorial kind of treatment, none of it really works, or there are occasions on both sides, so the treatments really do interact." [13-14]</p> <p>"if you're talking about salvaging people, usually, the best outcome is gonna be surgery first followed by FCOT." [27]</p> <p>"You could recommend radiation, but if you think that it's 50-50, and you're gonna have to operate, then you might be more likely to operate 'cause you don't necessarily want to operate right after somebody had radiation." [24]</p> <p>"Most patients who have surgery will also have radiation, so usually—at this point, it's pretty rare for them to do en bloc resections in metastatic patients where they're removing everything, and so the rates of local recurrent [unintelligible 06:04] are quite high, so usually, we will follow with radiation, and if it's diffuse disease, then we'll treat with conventional radiation. If it is very localized or [unintelligible 06:21] then we'll treat with stereotactic radiation." [Non-Op 1, 3]</p> <p>"I guess there's one other, but this is more like post-radiation, is sometimes we have patients in whom they get treated with radiation, and then a month or two later, they develop instability after the radiation. Then, clearly, they already received their radiation, and it would just be surgery alone. One could argue that, well, in that case, it is surgery plus radiation; it's just reversed." [Non-Op 2, 4-5]</p>
II. Guideline-Driven Care	

	<p>Participants relied heavily on guidelines to inform treatment decisions. Scoring systems were regularly used to quantify the extent of disease and contextualize indications for surgery.</p>	<p>“already mentioned the SINS score, which we use quite a bit. Radiation oncology is extremely—yeah, it’s just a very guideline-oriented [laughter]—all of them are, but it’s almost hyper. Anyways, but yes, we have a lot of guidelines. We have contouring guidelines for how we approach how we do radiation therapy. We have bone metastases guidelines that includes fine metastases. We have a number of ‘em, and there’s a good amount of literature regarding management of the spine. Of course, we always need more. Certainly, because we’re an academic program, we make a point of understanding that literature, contributing to that literature, and if there’s ever a case that pushes—and then there frequently are—our understanding of best management practices for a particular issue, then we’re always looking up what data’s available to guide that particular patient’s management, et cetera. Some of the literature you must already know because you’ve—deal with those patients all the time.” [Non-Op 2, 6]</p> <p>“Typically, we use the Spinal Instability Neoplasia Score. If any of those two factors are prompted, pretty much in the intermediate SINS, which anything basically above a seven, and/or any evidence of epidural tumor causing nerve root compression, cord compression, then immediately we’re thinking that a surgeon needs to fully evaluate the patients. If it’s a simple bone metastases that’s without any evidence of instability, without any evidence of soft tissue disease, then we are tending to think it’s—if they’re getting sent to me, it means they’re—if someone’s consulting me, it means it’s painful, and so we consider radiation therapy.” [Non-Op 2, 2]</p> <p>“if you’re talking about salvaging people, usually, the best outcome is gonna be surgery first followed by FCOT.” [27]</p> <p>“I’m saying, yeah, if we have complete injury. How much time? Say it’s one day, two days a week.” [7]</p>
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		<p>“I mean everybody does, and with most cancer surgery and whatnot, what the surgical indications are, and what the radiation indications are. There’s a lot of gray area, of course, but I think there’s pretty clear ones.” [12]</p> <p>“Progressive, acute, neurological condition is pushing you towards surgery, and highly unstable signs pushing towards medical.” [14]</p> <p>“...it needs to be based on specific framework guidelines because, otherwise, we’re just sort of saying, “Hey, this sounds good,” but there’s guidelines for this then as well.” [15]</p> <p>“we go off the guidelines, so, generally, how it’ll work is, okay, you look at non-symptoms framework, and I always dictate that, just from a practical standpoint. This is what we talked about at tumor board, and then you bring that to the family, and then, ultimately, they’re gonna have the say.” [15]</p> <p>“...the ablation for metastatic disease, it’s not technically part of the NOMS framework, but I’m just curious.” [22]</p> <p>“What cutoff do people use? If somebody comes in, and they’re paralyzed, and they’ve been paralyzed for X amount of time, we always talk about different times. Well, it’s too late for doing surgery on them. What numbers do people—do you guys have a number, or they just have to be strong?” [7]</p> <p>“The most commonly-used framework is...t the NOMS framework. We look at neurologic function, and if someone has neurologic deficits or high-grade 02:24 epidural disease, we typically consider that those patients need some sort of surgical intervention to decompress. If there is—if there are not neurologic deficits or high-grade epidural disease, then often, we view it as something that we can manage well with radiation alone.” [Non-Op 1, 2]</p>
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		<p>“The second factor in oncologic, and that’s really an indicator of radiation sensitivity. There are certain tumors, like myeloma, lymphoma, that melts away with radiation, and certain things like melanoma or renal cell carcinoma that are much more resistant to radiation, and then those kind of historically radio-resistant tumor sites then—we often will think more about stereotactic radiation to give a higher biologically-equivalent dose in order to try to get around that traditional radio resistance.” [Non-Op 1, 2]</p> <p>“Then the M of NOMS is mechanical. Patients that have mechanical—radiation does a great job of controlling cancer, but it doesn’t stabilize, so in patients who have mechanical pain or a high [unintelligible 03:49] score, then they either will need an invasive surgery to stabilize or [unintelligible 03:55] augmentation to try to stabilize. Then the S of NOMS is systemic factors, which is really kind of the big picture, so if someone has really diffuse disease and seems like they—and was very frail, then putting them through a surgery—even if they have neurologic deficits or mechanical instability—may not make sense, whereas patients who are doing very well and have limited disease, we have the—manage aggressively for—with the goal of dural local 04:31 control.” [Non-Op 1, 2]</p> <p>“patients having severe pain due to a clearly unstable spine, I think that, for us, I think that gives us the greatest push to offer an operation if the patient’s strong enough to undergo that.” [16]</p>
<p>III. Care Team Dynamics</p>		
<p>A. Multidisciplinary Care</p>		
	<p>Developing a comprehensive treatment plan necessitates input from a diverse range of disciplines (spine surgeons, radiation oncologists,</p>	<p>“in terms of multidisciplinary care—and I’m putting on my orthopaedic oncologist hat—we work with radiation and various other services all the time, but I think dealing with spine tumors just takes that to a whole ‘nother level because it’s such a complex</p>

	<p>medical oncologists, and palliative care).</p>	<p>decision-making process.” [7]</p> <p>“Yes. It’s inherently a multi-disciplinary, and so we talk with other providers all the time about every—basically—essentially every patient we see, we communicate with the other providers, and yes, we have a weekly spine tumor board on Wednesday mornings, but we also talk offline almost every day [laughter].” [Non-Op 1, 3]</p> <p>“Spine metastases, they require interdisciplinary management, in my mind, so I frequently—let’s say a patient is—we just had a patient recently who—they came in on an urgent issue that came in on a Thursday, and so all this—sent an email out to the team. “We can’t wait till next Wednesday when we have spine conference. Could you provide your thoughts?” Yeah. Like I said, we’re always interacting with the medical oncologists to understand the larger picture of the patient’s disease.” [Non-Op 2, 5]</p> <p>“There would definitely be a role for that, and more of a team approach where I think appointment burden for a lot of my patients with chronic pain can be a lot, and when you have copays, too, and multiple visits, so if there really was more of a collaborative team helping with questions.” [21]</p> <p>“that multidisciplinary approach, taking the oncologists and the spine surgeons into account, as well as including physical and occupational therapy and nutrition and psychology as well to optimize multidisciplinary care with a strong plan.” [3]</p> <p>“I would say that, as we think about this field in general, it is intensively multidisciplinary.” [7]</p> <p>“A team approach is really, really critical, experience-centered, [unintelligible 00:54:00] situated in the community.” [32]</p>
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		<p>“We definitely work closely with palliative care for pain management, and they also attend the spine tumor conference, but also the interventional pain folks, people that do interventional pain procedures on the spine, is another category that we sometimes— we’re really struggling to try to manage someone’s pain related to a spine issue, and we’ll get their help.” [Non-Op 2, 5]</p> <p>“I feel like our decision-making is not all that different than in cases where we have lots of time, because we have the structure in place that allows us to pretty quickly do that multidisciplinary assessment.” [Non-Op 2, 8]</p>
<p>B. Knowledge of Team Member Preferences</p>		
	<p>Participants recognized the importance of team-member familiarity. Participants felt that this characteristic allowed providers to infer treatment plans in the event that a group discussion was not feasible.</p>	<p>“I think there’s a big difference between having a radiation oncologist that we know, that we’ve worked with because you can kind of finish each other sentences a little bit, and so when they present to you this patient is surgical, they know you. You know them, and if they’re saying it, it becomes a different situation than if you’re told from somebody you don’t know, a radiation oncologist, ‘You need to see a surgeon so they can operate.’” [11]</p> <p>“I think it goes back to where, if you work with a specific radiation team, I think it’s always better, but these are variables that there.” [25]</p> <p>“sometimes there is a little bit of a knowledge gap with radiation oncologists, I think, with regards to what it is that we do during surgery, maybe not necessarily with the ones that we work with all the time, but for ones in the community or elsewhere, or even in the same institution, the ones that don’t necessarily treat spine all the time.” [25]</p> <p>“there’s some normal players, but on the weekend call where surgeons take the call, and they decide to do a surgery where classically we would radiate. Then they take out half of it or do</p>

		<p>something, and they call radiation oncology. Then someone like Kristen asks me, ‘Why’d they do this?’ I’ll say, ‘I can’t answer, but I’m sure that this doesn’t really jibe with what—’” [33]</p> <p>“One of the nice things I think everybody’s talking about, that interaction between surgeons and radiation oncologists, one of the nice things about what we do is that we both know that we’re both needed in these cases. It’s not like an either/or all the time, and I think that that removes a natural barrier that a lot of physicians typically have.” [13]</p> <p>“It’s much less sufficient in getting to a consensus, or at least to—it doesn’t have to be consensus.” [11] [re: familiarity of team members)</p>
	<p>The team is built in part by a structure (tumor boards) but in the event of no tumor board, the teams are still able to function because of these close relationships and a mutual understand of treatment preferences.</p>	<p>“...most places, you have in-depth discussions in tumor wards with partners, like radiation oncologists, oncologists, interventional radiologists as well, just to find the best plan.” [3]</p> <p>“how most people here do interact with other disciplinaries, so I don’t know if it’s through tumor board conference, or if you just touch base with whoever the radiation oncologist...” [10]</p> <p>“...anyone with any question will present the case at the spine tumor program. We are always interacting with the medical oncologists because typically, the spine surgeons, if we’re seeing the patient it’s because the medical oncologist has sent the patient to us, so we’ve already—they already have talked to us. Then, as far as involving the multidisciplinary spine team, we tend to have a very low threshold for anything that’s somewhat questionable to go ahead and present the case.” [Non-Op 2, 3]</p> <p>“I will say that if we didn’t have [multidisciplinary care]—and once upon a time, we didn’t... one of the reasons why we decided we needed a spinal tumor program, was it would be different if you</p>

		<p>suddenly had a patient that was at your doorstep, and you just did not have—you had to make a decision right away, and you didn't have time to have a whole interdisciplinary discussion about the patient's best management." [Non-Op 2, 8]</p> <p>"This is what we talked about at tumor board, and then you bring that to the family, and then, ultimately, they're gonna have the say." [15]</p>
<p>C. Communication Among Team Members</p>		
	<p>Participants maintained that working closely in a cohesive group facilitated productive communication that results in a definitive care plan.</p>	<p>"I try to communicate [with] the radiation oncologist and not tell them what I think they're gonna say. I'll communicate with radiation oncology and make sure that we are in agreement before I tell the patient." [10]</p> <p>"We have one person that does radiosurgery, but when that person's not around or whatnot, you get the average person, whoever's on. I've had, and I'm sure Joe has had arguments or conversations. That person says, "Oh, we'll set them up for eight gray and one fraction after surgery." We're like, "Well, wait a second. That's not really part of the package." Right? Then they get a little defensive, saying, "You're the surgeon, so leave the radiation to us. What do you know? Eight versus 18 versus 24 times 2. That's our thing." [26]</p> <p>"...it really depends on the multidisciplinary team, and so with all of these pieces communicating well. I feel like things are communicated in the way that I don't think I would want to see some things are communicated. Often, decisions are made without talking to other—without one team talking to another, and in those situations, it ends up seeming like we do a lot backpedaling because surgery isn't offered and should be, or vice versa." [33]</p> <p>"Yeah, I fully agree with what you said. We work closely. We have shared clinics and things like that, so we kind of can finish each other's sentences, I think. To your original about the disciplines, I think radiation's always part of the conversation." [12]</p>

		<p>“Better communications.” [34] [when asked how physicians can be more helpful to patients in making treatment decisions]</p>
<p>IV. Time Pressure/Urgency</p>		
	<p>If there is insufficient time for the multidisciplinary team to meet and discuss a treatment plan, or if a senior attending physician is not present and a less-experienced individual must make a decision, the treatment plan may be suboptimal.</p>	<p>“There’s often time pressure with these patients. Often they’re admitted to the hospital or...you suddenly had a patient that was at your doorstep and ...you had to make a decision right away, and you didn’t have time to have a whole interdisciplinary discussion about the patient’s best management.” [Non-Op 2, 8]</p> <p>“Not from how it’s presented to patients, but if I could change one thing about the process, it would be having—if they’re—the treatment planning for stereotactic radiation be much faster so that we could offer it to more patients.” [32]</p> <p>“It’s very similar to surgery where if we have a patient who has a spinal cord compression and neurologic deficits, then if they’re not a surgical candidate, we’ll actually treat them emergently and try to get that dose in immediately. The planning for stereotactic radiation is much more labor-intensive, so we really can’t offer it to patients who have—we try not to offer it to patients who have neurologic deficits or spinal cord compression ‘cause we can’t get it started fast enough.” [Non-Op 1,4]</p> <p>“Usually, we’re asking for help, and we might get an intern on medicine telling us on a Friday night 6 to 12 months because their attending will come in tomorrow, and we have to make a decision that night, and it’s not very informed.” [35]</p> <p>“but on the weekend call where surgeons take the call, and they decide to do a surgery where classically we would radiate. Then they take out half of it or do something, and they call radiation oncology. Then someone like Kristen asks me, ‘Why’d they do this?’ I’ll say,</p>

		<p>“I can’t answer, but I’m sure that this doesn’t really jibe with what—” [33]</p>
<p>V. Provider Experience/Capabilities</p>		
	<p>There are some providers and institutions with more experience and, thus, they are better equipped to effectively treat patients with spinal metastases.</p>	<p>“When you have an expert do something really well and publish how well it works, and someone cannot reproduce it because the technical or the logistical aspect of their hospital or their practice overestimates how good it is. They do something different then ‘cause it isn’t part of that.” [28]</p> <p>“Then that also allowed some to say, “‘did what they’re doing at New York,’ and they’re not giving the same dose after, and they’re not giving the same surgical range of decompression, and, therefore, they’re not having the same results, which were great results in the lecture. The MSK data was great, and I always used to say, ‘You have to really read what they’re doing or look at what they’re doing to get those results,’ so I agree with the problem around this issue.” [28]</p> <p>“I feel like in places like this we have such good—the surgeons are so experienced at managing cases who’ve had prior radiation that we probably maybe see a lot less of that than other maybe centers where they don’t see as much, operating in a field that’s seeing prior radiation.” [Non-Op 2, 8]</p> <p>“...again, just the fact that we have surgeons that are so experienced. I haven’t seen a lot of issues for those patients who’ve gone on to surgery after radiation, but maybe that’s due to the amount of experience.” [Non-Op 2, 9]</p>
	<p>Less-experienced clinicians and institutions may develop treatment decisions from published data but then fail to achieve similar results.</p>	<p>“...sometimes there is a little bit of a knowledge gap with radiation oncologists, I think, with regards to what it is that we do during surgery, maybe not necessarily with the ones that we work with all the time, but for ones in the community or elsewhere, or even in the same institution, the ones that don’t necessarily treat spine all the</p>

		<p>time.” [25]</p> <p>“If you have a relatively inexperienced person using ultrasound, they could think they’re better than they are, and you can’t always judge that by the imaging that they put in.” [29]</p> <p>“it really makes a difference what your partners from the radiation oncology side are willing to do, how comfortable they are. It’s like comparing a lot of the data out there, again, the stereotype they create in surgery data. Some radiation oncologists haven’t really developed that comfort level yet, so it really is more of a partnership, like an in-depth discussion.” [13]</p> <p>“Then he can have a very educated conversation because he understands it, but that’s not usually the case. Usually, we’re asking for help, and we might get an intern on medicine telling us on a Friday night 6 to 12 months because their attending will come in tomorrow, and we have to make a decision that night, and it’s not very informed.” [35]</p>
VI. Business Pressure		
	<p>Providers may implicitly experience pressure to overtreat or utilize expensive equipment despite equivocal indications.</p>	<p>“once you build one of these stereotactic machines or development, you’ve gotta use it ‘cause it’s a business model.” [18]</p> <p>“It’s over \$20 million for the proton beam at least. When you set that up, that will drive referral patterns by radiation oncologist departments. They will say, ‘Get ‘em in, whatever they need to be done.’ That may, unfortunately, bias when—I’m not saying it’s a perverse incentive. I’m saying that when you see a nail, and you have the biggest hammer, you might just see that it’s gonna change practice patterns.” [19]</p>
VII. Preference – Based Care		
A. Patient Expectations		

	<p>Participants emphasized the need to understand patient’s goals and focus on an individualized definition of quality of life.</p>	<p>“Patients sometimes will tell you, ‘My daughter’s getting married in two months, and I know I’m not gonna live through the year. I really wanna be there, and I want to walk her down the aisle,’ or what have you. That does shape, what can you offer? Are they gonna be still recovering from the surgery?” [20]</p> <p>“Definitely, always understanding patients’ values and goals, and as part of one’s assessment, together with fully assessing their pain and how their metastatic disease is impacting their overall functioning, quality of life.” [Non-Op 2, 6]</p> <p>"A lot of patients will say, “No, I wanna go home and spend that time with my family.” [4]</p>
	<p>Providers also emphasized the need to ensure that patients and families recognize that the disease is incurable and that preferences are aligned with realistic expectations for treatment-based outcomes.</p>	<p>We’ve done quite a bit of work in trying to basically place in their mind the basic expectations for surgical intervention, so sit down and say, “What do you think you’re going to get out of this? What’s your oncologist think that you’re getting out of this? Can you provide what you think you’re getting with the surgical path?” [3]</p> <p>“Having that discussion, I think, before I even walk into the room, so, that way, there’s a very clear expectation of what that patient wants.” [32]</p> <p>“Of course, it’s in large part framed by what patients is—hopefully doing well, what patients’ goals are. It’s a combination of—it’s overall quality of life and considering that both in the immediate term and then over the expected trajectory of their illness.” [Non-Op 2, 7]</p> <p>“It’s gonna be a very different conversation if the patient doesn’t understand that the disease is incurable, for example, than if the person that understands very well that their disease is incurable, and is very much okay with that. Let’s say their goal is next week to go on a trip. [Laughter] You know what I mean? That’s gonna impact your surgery decision.” [Non-Op 2, 12]</p>

		<p>“people think they’re going to be cured from something, when, really, all you can do is provide palliation.” [3]</p>
		<p>“People wanna stay ambulatory, so if you can keep them walking, it’s a main goal.” [19]</p> <p>“I think most of the patients are gonna not agree to surgery if you don’t offer them anything. If you offer them preservation of sensation, or maybe the ability to transfer. Maybe one is that you give them something that they could stand up with help, and to transfer from bed to wheelchair.” [9]</p>
<p>B. Patient/Family-Driven Care</p>		
	<p>Participants highlighted the important role that patients and families play in identifying the treatment strategy that is most conducive to preferences for care given the terminal nature of spinal metastases.</p>	<p>“ultimately, the patient and their family members drive the decision-making because it really—at the end of the day, it doesn’t matter what we think is medically best. It matters what is most consistent with their goals of care.” [Non-Op 1, 4]</p> <p>“This is what we talked about at tumor board, and then you bring that to the family, and then, ultimately, they’re gonna have the say.” [15]</p>
<p>VIII. Provider Perceptions of Quality of Life</p>		
	<p>Participants maintained that the provider’s perception of what will provide the best quality of life for the patient influences treatment recommendations.</p>	<p>“the overall goal at every sign point is preserving their quality of life, both pain, neurological symptoms, et cetera, and then it’s thinking, projecting their trajectory, and trying to do your best to think about things like local symptom control, and then also recurrence of disease at that site, and the possibility for complications like fracture, cord compression, et cetera, as someone has a longer trajectory with their disease.” [Non-Op 2, 7]</p> <p>“We might push toward just doing radiation alone in that patient, doing something very quick and getting them home, because their goals are—they’re heading home with hospice, and et cetera. That might be—the goal there is upholding their quality of life with the</p>

		<p>least interventions possible...” [Non-Op 2, 7]</p> <p>“One is to have maximal local control to prevent the tumor from coming back in that area, and then the other is to preserve quality of life so that patients have the best neurologic function for as long as possible and have as little pain as possible, like you just said.” [Non-Op 1, 4]</p> <p>“When patients are referred to me, my focus also is on pain management and improving quality of life and improving function, and so sometimes we might even offer things to address other muscle cell conditions and other interventional pain techniques.” [19]</p> <p>“If the patient can’t tolerate surgery, or when you talk to the medical oncologist and you understand that they will be extubated, and they’re not gonna be able to tolerate lying prone for an hour or two, or something that would just be a part of that knowledge stream.” [3-4]</p> <p>“We want to make sure that you do not feel fear, unless there’s an unstable situation, an unstable spine, but if we’ve already been given the go-ahead from the spine surgeon that they can participate in physical therapy and occupational therapy and move towards improving their function. I work with psychologist specifically. I’ll reach out to them or write a referral for psychiatry if needed as well, and I’m trying lately to connect my patients with social workers, but I’m finding it difficult from the outpatient post, so I’m trying to look into resources for my patients through social work.” [20]</p> <p>“I often ask if a patient’s pain is contributing to feeling depressed or anxious. I usually frame it from a pain standpoint.” [20]</p> <p>“Then taking into account the biopsychosocial effects and ramifications of having this diagnosis, and so working with the</p>
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		patients and their families to get the support they need, so whether it be through palliative care or psychology.” [20]
IX. Weight of Treatment Decision		
	<p>Participants maintained that patients and families readily understand that decisions for treatment have implications for longevity, morbidity, and function. As the advisor of care, participants recognized that they play an important role in the process and could sway decisions for treatment based on the way options or recommendations are presented.</p>	<p>“...we’re coming in as consultants, and we’re often meeting the patient for the first time. Sometimes we know the patient already, but sometimes we’re meeting the patient for the first time. They’re making some big decisions, whether it’s surgery for their cord compression, let’s say, or—and these decisions need to be made in light of that bigger picture. We’re immediately being put in this position of helping patients to grapple with that decision in light of the big picture of their [unintelligible 30:14], being able to do that well and thoughtfully with patients, I think—course, it’s difficult to do when there’s not a lotta time.” [Non-Op 2, 11]</p> <p>“Why do we need radiation afterwards? Why do they need it after surgery? You operated. You did the surgery.” I think it’s hard because these people are in a tough situation, right? They’re really vulnerable, and they’re trying to make a decision lying on a hospital bed, and everyone’s coming in pushing them to make a decision.” [16]</p>
X. Provider-Patient Relationship		
	<p>Participants emphasized the importance of an effective relationship with patients to foster communication and enable adequate appreciation of personal goals and values.</p>	<p>“The problem is that I think that we still have a long way to go to educate people that these options are there. A lot of people are out there, and once we do that, you might get the patients earlier. We’ve actually seen that as we talk to everyone. Now we’re lucky. We have a very captive referral audience, so we spent a lot of trying to educate that when you see the metastasis is this kind of thing, at least put it on our radar.” [17]</p> <p>“You need to have tremendous discussion with the patient and</p>

		<p>family. You're gonna talk to the family post-op, and they still ask, "Did you get it all?" [16]</p> <p>"if you're gonna have a discussion about options, certainly, the patient, it does happen, but family often has some insight as well I would say." [15]</p> <p>"A lot of it is making sure the patient understands the circumstances that they're in. There has to be time spent understanding what the patient understands about their disease, and that they are—that typically, again, we're seeing them because their disease is progressing; that they understand that their disease is progressing." [Non-Op 2, 12]</p> <p>"I think, varies provider to provider, but I think that physicians as a whole always need to try to remember to put themselves in the shoes of the patients and even—it might be a procedure that we do every day, so it may not seem like a big deal to us, but to the patient, this is all new and all terrifying, and being empathetic and understanding of that and to reflect on what it would be like to be in the patient's shoes." [Non-Op 1, 6-7]</p> <p>"When you're going into offer this treatment initially to a patient, if you prefer to offer a surgery, do you offer surgery alone, or do you consider, 'Well, there is an option for radiation, but we think that surgery's better?' How do you deal with presenting the treatment options to the patients?" [10]</p> <p>"most of it is just really having adequate time with the patients. We generally try to give plenty of time to have those discussions, but sometimes it's—especially in those situations where it is more urgent, it can be—for us to have much of an in-depth conversation, you're just trying to gather everyone, and get everyone's thoughts. Of course, you talk to the patient and their family, and understand</p>
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		<p>where they're coming from. It just ends up being—yeah, it ends up—in those certain circumstances, it can end up being a little bit rushed. I think, especially for advanced cancer patients, and particularly for those who are getting towards the end of their lives, it's sometimes like we're focusing—here we are talking about the spine metastasis, but there's a time and place, and frequently, for everyone to take a step back and consider what's happening with the patient, where they are, and making sure we're constantly circling back to that." [Non-Op 2, 10]</p> <p>"...the most critical thing is to know when to stop directing those patients because you could go on and on and on." [6]</p> <p>"Medical oncologists, just like you guys were talking about, when is enough?" [7]</p> <p>"What I mean by that, if you have a patient, when we get a patient that's already been seen by both radiation and oncology, and said, "We know this team have investigated. We really don't think we can offer anything except giving them more morphine." How much is invasive surgery for that patient really going to do?" [11]</p>
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