DEVELOPMENT OF A CANCER DECISION TOOL

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ABSTRACT

The Affordable Care Act and Medicare identify the need of a shared-decision model in health care. This model would improve patients' quality of life by removing the information barrier that currently exists between patient and physician. Using the shared-decision model and current technology, I developed a decision tool that facilitates the ability to make a timely shared decision. This tool has significant public health importance, in that improved decision making can add to the individual's quality of life.

The developed decision tool receives decisions from patients in regards to 28 questions over 8 specifically chosen criteria that have significant importance to patients with brain metastases, while the physician criteria has 5 patient specific factors that have significant importance in treatment options. All 8 patient criteria and 5 physician adjustment factors are reviewed in the literature to support the weighted impact on the treatment options: best supportive care, stereotactic radiosurgery, and whole brain radiotherapy.

Both patient and physician criteria are next analyzed within a custom developed matrix across the treatment options. The matrix design is based on a fuzzy analytic hierarchy process to calculate, rank, and show to a degree the best option in form of percentage fit for each treatment option. The final result can then be used in the discussion between patient and physician for developing a treatment pathway.

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1.0   INTRODUCTION

The following essay describes the development of a shared decision tool for patients who are diagnosed with brain metastases. The aim of the tool is to help these patients come to a timely decision on a treatment pathway. I will be exploring the design of the decision tool, which includes the patient criteria, physician adjustment factors, and the data matrix design. Overall, I hope to show a compelling example of how decision tools can impact health outcomes.

The Affordable Care Act (ACA) includes section 3506, which encourages the use of shared decisions for making health care decisions (Lee & Emanuel, 2013). Shared-decision tools are evidence-based tools designed to help patients make informed decisions about their medical care. The tools can take on many forms, including written booklets, cell phone applications, educational videos, etc. This shared decision process can be approached from many angles, from educating the patient to better understanding the treatment options to the development of aids that help the physician incorporate quality of life adjustments in the treatment choice. The advantages of shared decision aids can reduce the learning curve for patients and deliver outcomes that they can anticipate. The goal is to provide a tool for patients to understand the many facets of their care, including benefits, side effects, and cost. Shared decision making would benefit patients by improving quality of life and health outcomes (Lee & Emanuel, 2013).

Unfortunately, since the start of the ACA this vision of shared decision making has seen little enactment despite its importance as outlined in *Crossing the Quality Chasm* by the Institute

of Medicine (2001). For example, one study showed that only 41% of Medicare patients believed their treatment was consistent with their desire for palliative care over more aggressive options (Lee & Emanuel, 2013). Additionally, the Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments (SUPPORT), indicated that physician and surrogate decision maker's understanding of patient's preferences is only slightly better than chance (Covinsky et al., 2000). Covinsky et al.'s study also suggested that documenting advanced directives alone is insufficient in helping patients effectively voice their preferences. The information of patients frequently not voicing their opinions to their treatment providers is setting up the patient and the provider for failure. On one hand, the patient is choosing an unknown quality of life, and on the other the hospital is risking the patients desired quality of life.

Although many decision aids are still in development, some studies have demonstrated the efficacy of shared decision tools. A Cochrane Collaborative Review consisting of 86 studies showed how shared decision-making tools helped benefit both the patient and the hospital (Lee & Emanuel, 2013). Patients were more informed about their medical problems, were better able to predict risks and benefits, and were more confident about making healthcare decisions consistent with their values (Lee & Emanuel, 2013). In addition, the review showed how Implementation of shared decision tools reduced the frequency of expensive treatment options based on patient preferences, which then significantly decreases healthcare costs (Lee & Emanuel, 2013).

A typical visit to a physician office includes an exchange of personal information and a chance to receive treatment or preventative advice. This exchange requires the physician to gather the information, analyze test results, develop treatment options, and deliver recommendations or offer treatment options to the patient. This process has been effective in

most cases; however, this exchange becomes more complicated when a physician's recommendation is not clear and treatment options leave a patient indecisive. A good example is Atul Gwandy's father, who was a knowledgeable physician seeking a recommendation on a treatment pathway for his own diagnosis of a spinal tumor (Gawande & Petkoff, 2014). The choice between a high risk procedure or continued functional decline gave little indication of the resulting quality of life. It is this type of problem that I will be analyzing to see how a shared decision tool can be effectively developed for patients with brain metastases.

1.1   SCOPE AND FOCUS

The development of shared decision-making tools is highly relevant to the cancer population. Patients who receive a diagnosis of cancer may feel many emotions, including fear, confusion, and depression. The variety of cancer types, locations, prognoses, and treatment options can be overwhelming for patients who are already feeling stressed. One study examined the role of palliative care consultation for seriously ill cancer patients. There has been data that palliative care consultation can help improve patient outcomes, but Peter May's article goes further to demonstrate the cost savings as well (2015). Palliative care consultation within 6 days of hospitalization leads to 14% in savings ($1,312) and consultations within 2 days resulted in 24% savings ($2,280) (May et al., 2015). Palliative care consults can provide an effective, although timely, way to assess patient's preferences for feeling better mentally, physically, and emotionally. In essence, palliative care consults represent one tool to help facilitate the shared-decision making process for patients.

Among cancer patients, brain metastases develop in up to 17% of patients (Nayak, Lee, & Wen, 2012) with an estimated number of 170,000 new cases being diagnosed each year within the United States (Langer & Mehta, 2005). The prognosis is poor with a median life expectancy of up to 2 months for untreated and aggressive treatment yielding a median survival of up to 8 months (Colaco, Martin, & Chiang, 2015). This aggressive form of cancer has a wide variety of treatments due to the locality, multitude of symptoms and degrees of aggressiveness that can be used during treatment. Currently, there are three treatment pathways for brain metastases, which include surgery, radiation, and best supportive care (BSC). Surgical resection can be an effective treatment; however, the treatment is used in very selective cases (Hayat, 2014). As for radiation, this treatment is used due to the blood-brain barrier that presumes a resistance to systemic therapies as outlined in Hayat's study (2014). Radiation therapy includes whole-brain radiation therapy (WBRT) and stereotactic radiosurgery (SRS) (Langer & Mehta, 2005). The last treatment to consider is BSC, which is closest to not being treated, but includes medications to make the patient comfortable. The majority or approximately 70% of the BSC patients are receiving corticosteroids (Reali et al., 2015).

It can be very challenging for patients to understand these very complex treatment options during a stressful time period in their lives. Shared decision-making tools can help simplify the process and help patients better communicate preferences with doctors. A tool that utilizes current technologies to deliver a supplemental decision based on the physicians' understanding of the patient's current condition and the patients desired quality of life is the focus of this essay.

1.2   PURPOSE AND OBJECTIVE

The main purpose of this paper is to describe the development and utility of a shared decision-making tool for cancer patients. The tool would help both patients and physicians effectively communicate treatment options and decide upon the best treatment options for the patient. This partnering makes the most logical sense because the physician wants to deliver the best care, and this can only be accomplished with the creation of a process that includes the patient's preferences. The consistent utilization of shared decision aids is different from the current care delivery models. However, a focus on shared decision making would emphasize greater patient autonomy, self-efficacy, and quality of life.

When the patient is aware of the financial impact through the shared-decision tool, the choices can naturally shift to decisions that give a better quality of life. This model would derive decisions that refocus the discussions around choices that the physician did not initially interpret or cover thoroughly enough. It would also allow both parties to continuously adjust criteria and review the inputs through the supplemental guide. The information developed in the tool has the added benefit of transparently showing the elements that contribute to the decision.

Lastly, the incorporation of technology that is easily accessible is a focus in the design of the decision tool. The benefit of a dynamically adjustable web site would allow accessibility to the most devices, while a simplistic design pathway would reduce the learning curve required for the usage of the tool. Keeping the final design simplistic for both patient and physician would retain usage and allow the focus to remain on making shared-decision.

This essay will describe in detail the overall design of the tool. It will discuss the important variables to consider from both the patient and the physician's perspectives. Eight patient and 5 physician variables will be described. Next, the matrix for analyzing the data

inputs from the patients and physicians will be discussed. The essay will conclude with a discussion regarding some of the limitations of this shared-decision tool.

2.0   CANCER DECISION TOOL DESIGN

The decision tool was designed to be user-friendly for both the patient and physician. The tool consists of two parts: front-end (web interface) and back-end (algorithm). The design of the tool aligns with current development of interfaces, and will use a dynamically scalable interface that adjusts across multiple types of screen sizes and web browsers. Users can have a consistent experience and developers will not have to produce multiple versions of the same tool. This can all be accomplished by using content management system like WordPress®. Using WordPress® would allow the tool to have the largest market share possible through a browser, and allow the developer custom control over the entire user experience.

The decision tool can be hosted on academic servers with all the proper health check security measures, and the tool itself will not be saving user information. This strategy would allow the tool to be secure from the coding perspective, but allow the user reinsurance that private information would not be recorded. This type of methodology allows the decision tool to be more supplementary in making overall decisions due to the broad array of variables that might not be captured in a specific decision.
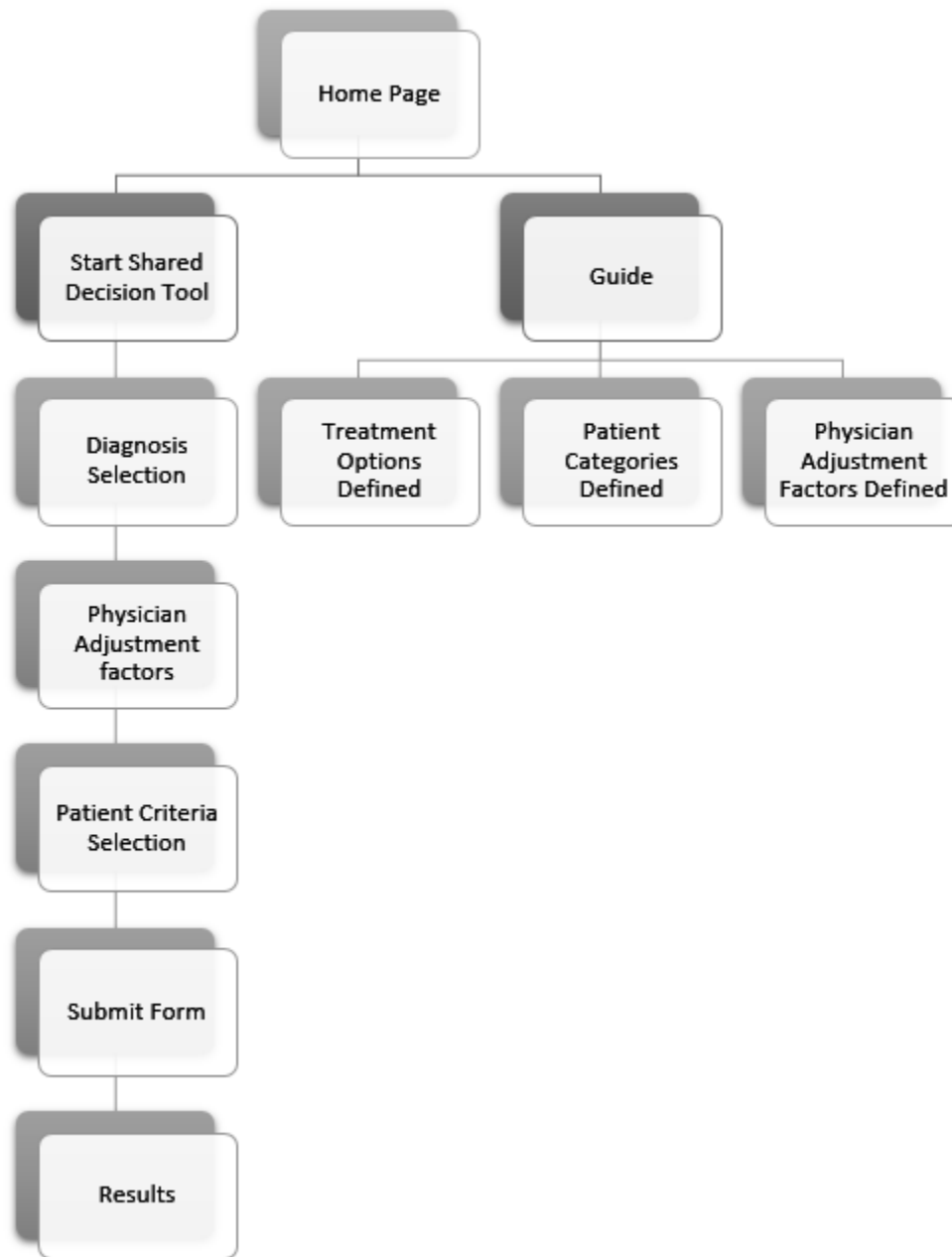
Figure 1. *Flowchart of decision tool's website frontend.*

The overall design of the website is relatively simple. See Figure 1. The home page would contain the objective, focus, and purpose of the website in a concise description. The navigation bar would provide a link to a guide for a description of the physician adjustment

factors and the criteria that the patient would be able to weight. Lastly, the decision tool would be front and center on the home page, so the patient can rapidly utilize the decision tool.

The tool pathway would broadly be composed of four steps: choosing a diagnosis, patient ranking the criteria, physician adjustment factors, and results. The first step in the pathway would be selecting a diagnosis. For, the wake of simplicity, the only option at this point would be brain metastases. This section could later be expanded to include a variety of options. However, the current setup will be focused on oncology with brain metastasis being the primary focused diagnosis.

Once the user has selected the diagnosis, the second screen would display two options. The first option would be the patient criteria. This section would give a list of preselected criteria that are important to the patient with the ability of the patient to easily weight each criteria according to importance. See Figure 2. The eight criteria of interest include: seizure control, hair loss, memory loss, medication side effects, remaining life span, number of trips to the hospital, length of visit, and burden of out-of-pocket cost. The second option would be the physician adjustment factors. See Figure 3. This section would allow the physician to adjust demographic variables. The factors would include: age, diagnosis of primary cancer, patient performance status, number of brain metastases, and extra-cranial disease.
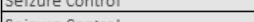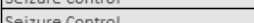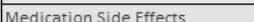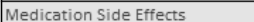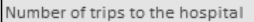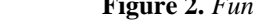
Patient Selection							
Question#							Selection Weight
1	Seizure Control	<			>	Hair Loss	5
2	Seizure Control	<			>	Medication Side Effects	1
3	Seizure Control	<			>	Memory Loss	9
4	Seizure Control	<			>	Number of trips to the hospital	1
5	Seizure Control	<			>	Length of Visit	1
6	Seizure Control	<			>	Length of Life	1
7	Seizure Control	<			>	Burden of Out of Pocket Cost	1
8	Hair Loss	<			>	Medication Side Effects	9
9	Hair Loss	<			>	Memory Loss	9
10	Hair Loss	<			>	Number of trips to the hospital	9
11	Hair Loss	<			>	Length of Visit	9
12	Hair Loss	<			>	Length of Life	9
13	Hair Loss	<			>	Burden of Out of Pocket Cost	9
14	Medication Side Effects	<			>	Memory Loss	5
15	Medication Side Effects	<			>	Number of trips to the hospital	1
16	Medication Side Effects	<			>	Length of Visit	1
17	Medication Side Effects	<			>	Length of Life	9
18	Medication Side Effects	<			>	Burden of Out of Pocket Cost	1
19	Memory Loss	<			>	Number of trips to the hospital	1
20	Memory Loss	<			>	Length of Visit	1
21	Memory Loss	<			>	Length of Life	5
22	Memory Loss	<			>	Burden of Out of Pocket Cost	1
23	Number of trips to the hospital	<			>	Length of Visit	5
24	Number of trips to the hospital	<			>	Length of Life	9
25	Number of trips to the hospital	<			>	Burden of Out of Pocket Cost	7
26	Length of Visit	<			>	Length of Life	9
27	Length of Visit	<			>	Burden of Out of Pocket Cost	9
28	Length of Life	<			>	Burden of Out of Pocket Cost	1

Figure 2. *Functional example of the Patient Selection Criteria.*

Physician Adjustment Factors							Selection Weight
Age	>50 ▼						1
Diagnosis of Primary Cancer	Lung ▼						1
Patient Performance Status	<				>		1
Number of Brain Metastases	5+ ▼						1
Extra-Cranial Disease	yes ▼						1
						Total	5

Figure 3. *Functional example of the Physician adjustment factors.*

2.1   PATIENT CRITERIA

This section will include a discussion of the eight patient criteria used in this decision tool.   They include seizure control, hair loss, memory loss, medication side effects, number/length of hospital visits, out of pocket costs, and remaining lift expectancy.   The relevance and significance of each criterion will be explained.

Seizure control is the first criteria. The direct radiation therapy on the brain increases the chance of a seizure for both SRS and WBRT treatments (Jairam, Chiang, & Yu, 2015). While BSC has less of a seizure risk, the seizure potential remains due to the presence of metastases in the brain. This means a person seeking a more aggressive treatment will have to incur a higher risk of seizure; however, other criteria and demographic factors could be involved. This is why it is important to have a thorough look at the remaining seven patient criteria.

The second side effect is hair loss. BSC treatments will not stimulate any loss of hair because this type of care is mostly focused around making a person comfortable with little medication interventions. Medications for BSC would be steroids and other medications that are unrelated to specific cancer treatments, and these medications will manage the symptoms and make the patient as comfortable as possible (Nieder, Norum, Stemland, & Dalhaug, 2010). The medication possibilities are vast, but substantially less aggressive than radiation treatment regimens. The SRS treatment will have a mild impact on hair loss due to a focused radiation treatment with a minimal number of treatments, while WBRT is a very aggressive treatment that will give the person complete hair loss due to the radiation of the entire brain over multiple treatments (Kleinberg, 2009).

The third criteria, memory loss, is another important variable individuals consider when choosing treatment options. The BSC treatment isn't going to put the patient at any further risk

than the brain metastases would present; however, the WBRT is going to drastically increase the chance of potential memory loss due to frequency and fraction size given to the patient(Kleinberg, 2009). According to Kleinberg, the benefit of SRS is that a focused beam of radiation therapy would potentially reduce the patient's risk of memory loss due to focusing on the brain metastasis and avoiding the normal tissue and critical structures (2009).

The forth criteria, medication side effects, will almost certainly impact the patients on BSC due to the broad delivery of medications designed to put the patient into the most comfortable state and preemptively avoid future complications. Kleinberg points out that the types of medications are broad due to the brains impact on the entire body (2009). On the other hand, the aggressive nature of SRS and WBRT will have radiation-related side effects such as increase in seizures, cognitive, and hair loss; however, medication strategies during radiation treatment are for only mitigating symptoms with medications (Kleinberg, 2009).

The number of hospital visits and length of visit are the fifth and sixth criteria. BSC isn't going to require any additional visits to the hospital for treatment, so both the length of visit and time spent have significant impact on the decision of patients that choose BSC. This means that patients choosing BSC will want to limit the amount of time spent traveling to the hospital and time spent within the hospital. The main difference in treatment times between SRS and WBRT is the upfront burden of treatments in WBRT, but SRS comes with the additional burden of indefinite scans post-treatment for the recurrence of brain tumors (Kleinberg, 2009). WBRT is the most aggressive with up to 54 trips to the hospital and less than 15-minute treatment times, while SRS is going to be fewer trips to the hospital with longer treatment times (Kleinberg, 2009).

The seventh criteria, the burden of out-of-pocket cost, is complex criteria for this decision tool. The burden can change drastically depending on a person's coverage, the time of year, and other patient specific financial situations. Due to complex pay structures in healthcare insurance and to make the tool broadly applicable, the financial burden is going to be focused specifically on out of pocket costs, and assuming the individual has health insurance due to the federal mandate. This cost can vary depending on the person's deductible contributions at specific times of the year, so this tool is going to assume that the deductible is at full burden. The max out of pocket burden of the bronze plan is $6,600 for individual plans and $13,200 for family plans as of 2015 (Boerner, 2015). The treatment costs for SRS and WBRT will be at the maximum burden of out of pocket costs considering the most conservative treatment regimen (Higginson, Hubbs, & Morris, 2009). The other consideration is BSC, which would depend on medications to maintain symptoms and would be nominal costs to no cost to the patients.

The last criteria, number eight, would be the remaining life expectancy. This criterion can be weighted by the patient, but it will also be adjusted based on the physician adjustment factors. The adjustment factors are important because these factors could make the weight less important due to the patient specific demographics. Someone at an older age, significant number of brain metastases, and extremely low patient performance may have a minimal adjustment to life expectancy, while someone in better health and lower risk factors would be expected to have a longer life expectancy.

2.2   PHYSICIAN ADJUSTMENT FACTORS

The physician adjustment factors allow the physician to adjust demographic variables that additionally adjust the weights of the patient criteria. In the initial adjustment setup, the factors chosen will directly impact the remaining life expectancy criteria. This will be accomplished through five specific adjustment factors. While many adjustment factors could be chosen to impact this criteria, the five chosen have reasonable evidence to support the significant impact on life expectancy.

The first factor, age, has been shown to be a determinant of survival when considering patients with brain metastases (Stark, Tscheslog, Buhl, Held-Feindt, & Mehdorn, 2005). Additionally, the cancer patient population overall has shown incidence patterns as well as evidence that shows survivability is often linked to the age at diagnosis (Corazziari, Quinn, & Capocaccia, 2004). While research is lacking in regards to patients under the age of 50 years, evidence does support an association between shorter survival and brain metastases at age of diagnosis with older patients having a worse prognosis (Leone, Lee, & Brufsky, 2015).

The second factor, diagnosis of primary cancer, is very broad in scope. Therefore, I needed to narrow down the focus by starting with the highest percentage of primary cancer. The top three primary cancers in order of highest to lowest are lung cancer, breast carcinoma, and malignant melanoma (Colaco et al., 2015). These three alone will cover the majority of primary cancers, but the tool will allow easy expansion into additional primary cancer diagnoses.

The third factor is patient performance status. This can be assessed through several different types of tools that are well documented. In the field of oncology, the primary tool used to assess functional status is the Karnofsky Performance Status. This measure translates into a

percentage value (100% being symptom free and 0% being death) that would easily fit into the construct of the decision tool(Peus, Newcomb, & Hofer, 2013).

The fourth factor, extra-cranial disease, disregards treatment, and delivers a consistent 5-month median survival rate regardless of radiation treatment pathway (Wroński & Lederman, 1997). This overall reduction to radiation treatment pathway will impact these treatment weights when selected in the tool. This type of reduction could make BSC a better option when survival length is of high importance, but the deviation between BSC, WBRT, and SRS is nominal.

The last factor, number of brain metastases, has a significant impact when considering survival and the type of treatment. Evidence has shown that a person with small brain metastases with less than four inches will show improvement with either WBRT or SRS (Mehta et al., 2005). The evidence beyond this amount or size has been scarce, but consideration for WBRT increases as the number of brain metastases increases and with the presence of small cell tumors (Hayat, 2014). Additionally, a lack of evidence for the number of brain metastases beyond four is a presumption that survivability is lower as the number of brain metastases increases.

2.3   DECISION TOOL OUTPUT

The next step for the decision tool is the output. Two important considerations should be taken before designing the complex matrix. The first being the nuts and bolts of how the tool could realistically be constructed to produce the end result of weighted treatment options. The second being a review of the patient criteria and physician adjustment factors to make sure the output for brain metastases would yield a differentiated result.

When both the patient and physician sections are completed, the option to view the results will be enabled. The result values will be calculated on the backend using a Microsoft MySQL® database and on the front end using the fuzzy analytic hierarchical process (FAHP). This combination will consist of a matrix that can adjust the patient criteria based on the physician adjustment factors. The treatment options will then be adjusted on a likely fit based upon the weighted choices and physician adjustments. The visual result will be a percentage fit out of 100 on how each of the three treatment options fit with the weighted criteria.

In the case of brain metastases and yielding a differentiated result, the three treatment options described previously are different enough that the results will always have a significant spread between them. This fact is important because all choices need to produce significantly different results based on individual's choices; otherwise, the patient and matrix would remain indifferent among choices, and this indifference would defeat the purpose of making a choice. Additionally, obvious dominant choices would also make the tool useless. In this scenario, these two situations are factored out because several quality of life factors create completely different choices based on the patient's selection.

2.4   MATRIX DESIGN

Thomas Saaty developed an "Analytic Hierarchy Process" (AHP) that was used for the backbone of the decision analysis tool (Saaty, 2013). The reason it is the backbone and not the complete basis of the matrix is due to a lack of hierarchical criteria. Meaning that the criteria within my matrix has no advantage over another option; therefore, ranking them is not possible. The example of this situation would be criteria A is better than B and criteria B is better than

criteria C; therefore, criteria A must be better than C. This hierarchy does not work with criteria such as memory loss, the number of visits made to the hospital, and hair loss because they do not have an exact order of importance. Each criterion compared will subjectively have different importance to each patient. The subjective nature of the choices also eliminates the need for a consistency ratio to confirm the decisions made are consistent with hierarchy. Additionally, the AHP matrix is going to employ fuzzy ratios. This is due to the inability to find exact ratios among the choices, but gives weight to the decision because even though the choice is not exact, a difference can be determined between the criteria.

The first part will be a pairwise matrix comparison between the eight criteria, see figure 4. This pairwise matrix will be able to dynamically adjust as a patient chooses between all 28 comparisons of the criteria. This table data will next be normalized for each patient, and averages will be calculated for the criteria weights, see figure 5. The next calculation would be the average of the normalized data rows. This would generate the average weights to be used in calculating the final choice weights.

		COLUMN CRITERIA							
		Seizure Control	Hair Loss	Medication Side Effects	Memory Loss	Number of trips to the hospital	Length of Visit	Length of Life	Burden of Out of Pocket Cost
ROW CRITERIA	Seizure Control	1.000	1.000	9.000	0.111	9.000	9.000	9.000	9.000
	Hair Loss	1.000	1.000	0.111	0.111	0.111	0.111	0.111	0.111
	Medication Side Effects	0.111	9.000	1.000	1.000	9.000	9.000	0.111	9.000
	Memory Loss	9.000	9.000	1.000	1.000	9.000	9.000	1.000	9.000
	Number of trips to the hospital	0.111	9.000	0.111	0.111	1.000	1.000	0.111	0.200
	Length of Visit	0.111	9.000	0.111	0.111	1.000	1.000	0.111	0.111
	Length of Life	0.111	9.000	9.000	1.000	9.000	9.000	1.000	9.000
	Burden of Out of Pocket Cost	0.111	9.000	0.111	0.111	5.000	9.000	0.111	1.000
	SUM Columns	11.556	56.000	20.444	3.556	43.111	47.111	11.556	37.422

Figure 4. *Patient criteria pairwise comparison matrix.*

ROW CRITERIA	COLUMN CRITERIA								Average of rows (Criteria Weights)
	Seizure Control	Hair Loss	Medication Side Effects	Memory Loss	Number of trips to the hospital	Length of Visit	Length of Life	Burden of Out of Pocket Cost	
Seizure Control	0.087	0.018	0.440	0.031	0.209	0.191	0.779	0.240	0.249
Hair Loss	0.087	0.018	0.005	0.031	0.003	0.002	0.010	0.003	0.020
Medication Side Effects	0.010	0.161	0.049	0.281	0.209	0.191	0.010	0.240	0.144
Memory Loss	0.779	0.161	0.049	0.281	0.209	0.191	0.087	0.240	0.250
Number of trips to the hospital	0.010	0.161	0.005	0.031	0.023	0.021	0.010	0.005	0.033
Length of Visit	0.010	0.161	0.005	0.031	0.023	0.021	0.010	0.003	0.033
Length of Life	0.010	0.161	0.440	0.281	0.209	0.191	0.087	0.240	0.202
Burden of Out of Pocket Cost	0.010	0.161	0.005	0.031	0.116	0.191	0.010	0.027	0.069
SUM Columns	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

Figure 5. *Patient criteria pairwise comparison matrix normalized.*

Once the averages for each criterion are calculated, the choices will need the same procedure performed to get an average weight. The only difference between the criteria and choice weights will be that the choice weights will be individually applied to each of the criteria, and the weights used for the choice calculations are evidence based. The pairwise tables for the choices will be 3 by 3 tables that compare BSC, SRS, and WBRT within 7 of the 8 selected patient criteria. The eighth criteria, remaining life expectancy, will use the physician inputs to adjust the last pairwise table.

The treatment choices will be calculated from the collective inputs of patient and physician. This will be accomplished by multiplying the choice pairwise averages to the criteria averages and summing all these together for each of the choices. The result will be converted to a percentage out of 100, and will allow an easy comparison between BSC, SRS, and WBRT. The largest percentage among the three treatment choices will be the recommendation of the decision tool.

Lastly, it is important to note that the pairwise tables shown are only functional examples because the website will actually be calculating the values in real time as the inputs are

completed by the patient and physician. This dynamically adjustable website will allow the patient to rapidly see different scenarios by altering decisions. The advantage of the adjustments can allow the patient to see rather little impact or large impact based on the decisions made in relation to the physician adjustment factors.

3.0   LIMITATIONS

The limitations of the decision aid are the weights, validation, and technology.   The current determination of both patient and physician weight adjustments are currently based on evidence found in a variety of studies, and a greater determination of the relationship would benefit from a dedicated randomized trial that could more specifically determine the adjustments for this specific decision tool. This would allow the tool to be calibrated within the confines of the specific criteria and physician adjustment factors chosen for this tool.

The chosen criteria and adjustment factors are another limitation due to the broadly chosen criteria. The best tool would deliver a customizable and unlimited set of criteria for the variety of patient situations; however, this hypothetical tool comes with the complication of determining the weighted impact of the physician adjustment factors. Additionally, physicians could potentially have different evidence based factors that would impact the patient's mortality or quality of life. However, these factors will need validation or adjustment within the construct of the decision tool. These adjustments lead to a different limitation—that is, a requirement to keep an updated and verified tool. This will be extremely important to assure physicians and patients are getting decisions that make sense. The limitation is anticipated by allowing an accessible backend for quick and easy adjustments. However, research will be necessary to keep the accuracy of the matrix and a clear policy for checking the date of the last update. The

combination should reduce concern, and a constant validation of the matrix will verify accuracy of the tool's results.

A final limitation would be technology. The ultimate tool would allow information to be stored and compared to other decisions made by patients to create a dynamically adjustable database based on patient and physician inputs; however, the abundance of security risks with storing private information online reduces the interest in incorporating a tool that could deliver the additional benefit of improving the results based on input. This limitation could be circumvented with reduced risks. But the best solution is currently to create a tool that doesn't save information, which completely eliminates the security risks.

4.0   DISCUSSION

The health care landscape is changing to consider better quality outcomes, but it is also changing to incorporate the patient's perspective of a better quality outcome. The patient decision is a new perspective because physician perceived quality metrics are being challenged. While a physician is looking to get the patient a medically better outcome, the patient may have alternate opinions on the definition of a better outcome. This new shared-decision tool aims to deliver decisions based on the combination of both perspectives to obtain the goals of the patient, while intrinsically including the medical expertise of the physician.

Despite any possible limitations, the direction of this shared decision tool has significant potential. The eight patient specific criteria give a different perspective to the physician that each person has options that may contrast with the five physician factors when deciding on a treatment. A good example to recall from this essay is memory loss and primary diagnosis. While the physician is interested in discovering the primary diagnosis to give a treatment suggestion that would extend the patient's life, the patient may not be willing to risk his mental capacity on significantly better prognosis with a more aggressive treatment. For this reason and many others considered in the essay, the tool designed takes all decisions into consideration to give a best decision by using a FAHP.

The next steps in the evolution of this tool will be developing the website outlined in this essay. The tool will be discussed with administrators and physicians at a research cancer center.

Consent forms will be written and a pilot cohort of patients will be selected to test the decision tool. Data will need to be collected regarding both the patient and physician's user experience. Further steps include identifying what kind of follow-up data needs to be collected and determining how to follow through in obtaining this information.

If this tool proves useful through a reliable and useful aid, I see expansion of the framework to other areas that have immediate need. This may include other medical specialties or patient populations. The design of the website will allow easy adjustment or additions, which makes the tool useful in the diversity of health care.

In conclusions, the usefulness of the tool will be proven through third party patient feedback on understanding the treatment and the satisfaction of the choice. Additionally, when the tool matures and becomes a part of standard care, the main indicator of success would be the increase in Medicare patients that believe treatments are consistent with desired treatment pathway. These long term goals seem farfetched; however, a tool that can quickly aid in decisions and give patients back confidence in decisions through a technology with rapid deployment has the potentially for impact in health care decisions.

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