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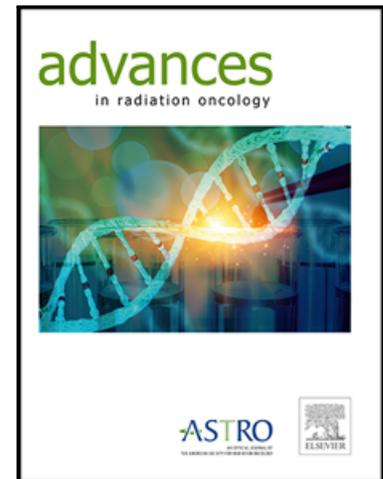
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Hazardous attitudes in radiation oncology

Hazardous Attitudes: Physician Decision Making in Radiation Oncology

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Abstract:

Purpose: The Federal Aviation Administration quantifies hazardous attitudes (HA) among pilots using a scale. HA have been linked to aviation risk. We assessed the influence of HA and other factors in treatment decision making in radiation oncology (RO).

Materials/Methods: An anonymous survey was sent to 809 radiation oncologists in cities housing the top 25 cancer centers. The survey included a HA scale adapted for RO and presented nine cases assessing risk-tolerant radiotherapy (RT) prescribing habits and compliance with ASTRO's *Choosing Wisely* recommendations. Demographic and treatment decision data were dichotomized to identify factors associated with prescribing habits using univariable (UVA) and multivariable (MVA) logistic regression analyses.

Results: 139 responses (17.1%) were received and 103 were eligible for analysis. 40% were female; ages were evenly distributed. 83% were in academics. Median scores for all attitudes (macho, anti-authority, worry, resignation, impulsivity) were below aviation thresholds for hazard and data from surgical specialties. On MVA, responders >50 years

old with >5-years' experience were 4.45 times more likely to recommend risk tolerant RT (p=0.016). Macho attitude was negatively associated with *Choosing Wisely* compliant treatments (Odds Ratio [OR] 0.12, p=0.001). Physicians who reported having previously retreated the supraclavicular fossa without complication were more likely to recommend retreatment in medically unfit patients if they felt the complication was avoided due to careful planning (OR 5.2, p=0.008)

Conclusion: To our knowledge this represents the first study analyzing physician attitudes in RO and their impact on self-reported treatment decisions. This work suggests that attitude may be among the factors which influence risk tolerant prescribing practices and compliance with *Choosing Wisely* recommendations.

INTRODUCTION

While radiation oncology (RO) is data driven and evidence based, there exists considerable variability in physician decision-making. In fact, a leading RO journal developed a regular feature showcasing nuance and variability in practice, titled “The Gray Zone.”¹

Physician decision-making remains overall poorly understood, although likely influenced by many factors. The airline industry has found attitude to be a significant factor in decision making.² The Federal Aviation Administration (FAA) tests all pilots for Hazardous Attitudes (HA)—those contributing to poor decision making and risky behavior.³ Five HA are recognized: anti-authority, impulsivity, invulnerability, macho, and resignation (**Table 1**),⁴ and they have been implicated in plane crashes.⁵ In the

modified short HA scale, the single attitude invulnerability is broken down into lack of worry and excess of self-confidence.

In recent years, the concept of HA has been applied to medicine among orthopedic surgeons, demonstrating association between HA expression and rates of reoperation and readmission.⁶⁻⁸ This work suggests that the hazardous attitude scale used to determine safe practices in pilots may have merit in medical decision making as well. As radiation oncologists make high impact decisions affecting the lives of cancer patients routinely, the factors associated with good judgment in radiation oncology would be valuable. The baseline expression of HA and their influence on physician decision making in RO is unknown. In this study, we conducted a survey analysis of radiation oncologists to assess the presence and influence of HA in treatment decision making.

METHODS AND MATERIALS

Study design and participants

We developed an anonymous survey including an adapted version of the HA Scale. The institutional Human Investigations Committee deemed this work exempt from review (XXXX). The online survey was distributed to 809 radiation oncologists registered with the American Society of Radiation Oncology (ASTRO) in the U.S. cities housing the top 25 cancer centers (U.S. News and World Report rankings) over a 2-month period via email, ending December 2017. Practicing radiation oncologists were eligible. Consent was obtained and confidentiality was maintained.

Survey development

We pilot-tested our survey with practicing radiation oncologists to assess questions for clarity and meaning. The survey included 70 close-ended, multiple-choice questions. It consisted of four major components: (1) an attitudes survey using the aviation HA Scale adapted for RO, (2) four clinical scenarios to assess willingness to prescribe risk tolerant treatments (towards organs at risk (OARs)), (3) practice scenarios based on five ASTRO *Choosing Wisely*⁹⁻¹¹ recommendations, and (4) demographic data.

Originally an ipsative measurement scale, the instrument assessing HA was modified into a Likert-type scale and validated.¹²⁻¹⁶ We used an abbreviated 30-item version of the scale consisting of declarative statements adapted for RO.¹⁴ This short scale was selected to be consistent with literature examining HA in medicine that measure self-confidence and worry rather than invulnerability. Statements such as “I like to practice unusual aircraft attitudes” were converted to “I like to practice unusual treatment paradigms in radiation oncology.” Like in the aviation scale, five unique questions to assess each attitude (macho, anti-authority, worry, resignation, impulsivity, and self-confidence) were included. Threshold for concerning levels of individual HA expression was consistent with aviation survey grading.¹⁴

The survey then assessed two sets of clinical scenarios: prescribing habits and adherence to society guidelines. Four cases aimed to understand nuances in prescribing habits including risk tolerance. These four cases included: 1) RT allocation for an elderly woman with stage I breast cancer eligible for RT omission, 2) prescribing habits for an ultra-central lung tumor, 3) retreatment dose-fractionation of the supraclavicular fossa for a symptomatic breast cancer patient who received prior RT, and 4) balancing risk of RT pneumonitis with adequate PTV coverage in lung cancer. Risk tolerance for the purposes

of this study was relative to the organs at risk, such that whole breast RT prescription was considered more risk tolerant than partial breast RT, and stereotactic body RT prescription was considered more risk tolerant than conventionally fractionated RT for an ultracentral lung cancer. In the first three cases, variations of patient health were presented. For the case involving retreatment of the supraclavicular fossa, an additional question (Why do you feel you did not observe a complication with retreatment?) was presented if respondents reported prior experience in retreatment of this area without complications. Respondents were asked if they thought the absence of complications was due to chance, careful planning and delivery, or short patient survival.

ASTRO's *Choosing Wisely* guidelines are well-known and felt to represent information that general practitioners would be aware of, even outside of their disease site specializations. Respondents were asked about their preferred treatment in patient scenarios representing targets of ASTRO's prior *Choosing Wisely* campaigns: management of bone metastases, low risk prostate cancer, low risk endometrial cancer, brain metastases, and the use of hypofractionated whole breast RT.¹⁰⁻¹¹ Answer choices were classified as *Choosing Wisely* compliant or non-compliant.

Non-identifiable physician demographics and practice characteristics were also queried.

Data analysis

Descriptive statistics were used to characterize the cohort and HA expression. Demographic data, practice patterns information, and HA responses were dichotomized for univariable (UVA) and multivariable (MVA) logistic regression analyses. The

attitude self-confidence was not analyzed for association as radiation oncologists—unlike surgeons and pilots—do not primarily rely on physical abilities, but rather performance of team members (dosimetry, therapy, physics) for job execution. For MVA, an interaction term including age and years since residency was created. We used UVA to identify demographic factors and HA associated with compliance with *Choosing Wisely* recommendations and risk tolerant (to OAR) prescriptions. Both UVA and MVA were used to identify demographic factors, practice characteristics, and HA associated with risk tolerant prescriptions. Additional UVA was performed to determine whether prior experience with a particular treatment scenario was associated with increased or decreased likelihood of risk tolerant prescribing. Statistical significance was defined as $p \leq 0.05$. Stata SE 13.1 (Stata, College Station, TX) software was used.

RESULTS

Respondent demographics

Of the 809 surveys sent, 139 were started, yielding a response rate of 17.1%. Additionally, 12 surveys were accessed by anonymous link. Excluding responses submitted as blank (N=2), with significant missing data (N=14), or without consent (N=2), 103 surveys were eligible for analysis. There was a male predominance in responses, and ages were evenly distributed (**Table 2**). Most respondents practiced in academic centers or university settings, completed residency within the prior ten years, reported an average of 11-30 patients on treatment during a typical week, and worked regularly with more than six RO colleagues.

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Median scores for all HA were below aviation thresholds for hazard (**Table 3a**). Hazardous levels of macho were expressed in 15.6% of respondents and hazardous levels of worry in 12.5% (**Table 3b**). Gender was not significantly associated with hazardous levels of any attitude (data not shown).

Factors associated with risk tolerant prescription

On UVA, age >50 (odds ratio [OR] 3.65, 95% confidence interval [CI] 1.39-9.56, $p=0.008$) and experience >5 years (OR 3.18, CI 1.08-9.37, $p=0.036$) were significantly associated with risk tolerant prescribing. On MVA, respondents >50 years old with >5 years of experience were 4.45 times more likely to recommend risk tolerant prescriptions (CI 1.32-15.0, $p=0.016$, **Table 4**).

Previous experience and perceptions surrounding complication avoidance were also associated with prescribing preferences. Physicians who reported prior experience irradiating the supraclavicular fossa without complication were significantly more likely to recommend retreatment in poor health patients if they felt the complication was avoided due to careful planning and delivery rather than chance or patient death (OR 5.2, CI 1.55-17.61, $p=0.008$).

Compliance with Choosing Wisely Campaign

The macho attitude was negatively associated with compliance with *Choosing Wisely* recommendations (OR 0.12, CI 0.03-0.40, $p=0.001$). There was no association with any other HA or demographic/practice characteristic (**Table 5**).

DISCUSSION

The role of attitude in decision making has been well-established in the aviation industry. Given the recent application of this concept to surgical specialties,⁶⁻⁸ we sought to determine the influence of HA and other factors on physician decision making among radiation oncologists. Our analysis demonstrated low levels of HA among radiation oncologists. The macho attitude was associated with non-adherence to *Choosing Wisely* recommendations, while older age and more experience were associated with a propensity to recommend risk tolerant prescriptions. We also found that retreatment was almost five times more likely to be recommended when the physician felt that careful planning was responsible for avoidance of a complication. To our knowledge, this represents the first study examining hazardous attitudes in RO.

It is not clear why older age and more experience are significantly associated with an increased likelihood of recommending risk tolerant (to OAR) prescriptions. This difference could reflect the influence of the three-dimensional era, where more dose volume metrics are available, shifting focus on preventing complications. Alternatively, the threshold of 5 years of practice to observe this effect could indicate having practiced long enough to see recurrences, shifting priorities from avoiding complications to avoiding recurrence.

While our study is thought provoking about the role of attitude and other factors in decision-making in RO, there are limitations. First, there is potential nonresponse bias. Mean response rate for email surveys is ~36%, with recent data exhibiting lower response rates.^{17,18} Among oncology surveys, RO surveys may have response rates as low as 5%.¹⁹

Our respondents also included a large number of academic physicians and might not be representative of the total population of radiation oncologists. The influence of training site, disease site specialization, local practice culture, peer influence, and era of training cannot be reliably assessed by this data but are likely to contribute to prescribing preferences. Finally, given that prescribing too much or too little RT can both be risky, it would be worthwhile to determine whether HA are correlated with prescriptions that are risk tolerant for recurrence.

CONCLUSIONS

Our study demonstrates low levels of HA in radiation oncologists compared to pilots and orthopedic surgeons. However, the macho attitude was associated with nonadherence to *Choosing Wisely* recommendations. Other factors, such as increasing age and experience were associated with a propensity to recommend risk tolerant (to OARs) prescriptions. To our knowledge this is the first study examining physician attitudes in the field of RO. This work lays the foundation for further efforts to identify factors associated with physician decision making in this field.

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Table 1. Definitions and antidotes for Hazardous Attitudes officially recognized by the Federal Aviation Administration.⁴

Hazardous Attitude	Definition	Antidote
Macho	“I can do it.”	“Taking chances is foolish.”
Anti-authority	“Don’t tell me.”	“Follow the rules. They are usually right.”
Resignation	“What’s the use?”	“I’m not helpless. I can make a difference.”
Impulsivity	“Do it quickly.”	“Not so fast. Think first.”
Invulnerability	“It won’t happen to me.”	“It could happen to me.”

*Worry and self-confidence are attitudes not officially recognized by the Federal Aviation Administration as hazardous, although are routinely measured.

Table 2. Demographic and practice characteristics of respondents eligible for analysis (N=103). No. (%) of patients.

Variable	N (%)
Age (years)	
<35	23 (22.33)
35-40	25 (24.27)
41-50	26 (25.24)
51-60	18 (17.48)
>60	11 (10.68)
Gender	
Male	61 (59.22)
Female	41 (39.81)
Not Reported	1 (0.97)

Years since residency	
Still in training	3 (2.91)
0-5	38 (36.89)
6-10	21 (20.39)
11-15	8 (7.77)
16-20	9 (8.74)
>20	24 (23.30)
Practice setting	
Academic/University	85 (82.52)
Private Practice free standing	5 (4.85)
Private practice hospital based	8 (7.77)
Military/Government	1 (0.97)
Other	4 (3.88)
Average number of patients on treatment	
0-10	20 (19.42)
11-20	60 (58.25)
20-30	21 (20.39)
>30	2 (1.94)
Number of RO* colleagues	
0	2 (1.94)
1-5	27 (26.21)
6-10	28 (27.18)
>10	46 (44.66)

*RO = radiation oncology

Table 3a. Hazardous attitudes levels among respondents.

Hazardous Attitude	Median (Range)	SD*
Macho	15 (7-24)	3.48
Anti-authority	9 (5-20)	3.03
Worry	15 (6-23)	3.80
Resignation	12 (6-19)	2.94
Impulsivity	15 (8-21)	2.53

*SD = standard deviation.

Table 3b. Rates of hazardous levels of Hazardous Attitudes among radiation oncology, neurosurgery*, and orthopedic surgery (Hazardous Attitude score>20).⁶

Hazardous Attitude	Radiation Oncology	Neurosurgery	Orthopedic Surgery
Macho	7.8%	0.0%	28%
Anti-authority	0.0%	1.5%	3%

Worry	9.7%	3.7%	6%
Resignation	0.0%	7.7%	0.3%
Impulsivity	1.9%	0.4%	1%

*From: Muskens IS, van der Burgt SME, Senders JT, Lamba N, Peerdeman SM, Broekman ML. Behavior and attitudes among European neurosurgeons - An international survey. *J Clin Neurosci.* 2018;55:5-9. doi:10.1016/j.jocn.2018.07.019

Table 4. Univariable and multivariable logistic regression analysis for variables potentially associated with willingness to recommend risk tolerant prescriptions (radiation doses that pose greater risk to the organs at risk) in surveyed scenarios. Variables with empty spaces in multivariate column were not included in the final MVA model.

Variable	Univariable OR* (95% CI [†])	P	Multivariable OR* (95% CI [†])	P
Age (years)				
≤50	1 [Reference]	N/A		
>50	3.65 (1.39-9.56)	0.008		
Gender				
Female	1 [Reference]	N/A		
Male	0.86 (0.34-.2.21)	0.76		
Years since residency				
≤5	1 [Reference]	N/A		
>5	3.18 (1.08-9.37)	0.036		
Age (years) & years since residency				
≤50 & ≤5			1 [Ref]	N/A
>50 & ≤5			N/A	N/A
≤50 & >5			1.65 (0.46-5.93)	0.44
>50 & >5			4.45 (1.32-15.0)	0.016
Practice Setting				
Academic	1 [Reference]	N/A	1 [Reference]	N/A
Other	0.38 (0.08-1.67)	0.19	0.31 (0.06-1.64)	0.17
Number of patients on treatment				
<21	1 [Reference]	N/A	1 [Reference]	N/A
≥21	2.13 (0.77-5.9)	0.14	2.36 (0.77-7.19)	0.13
Number of RO[‡] colleagues				
0-10	1 [Reference]	N/A		
>10	1.32 (0.53-3.3)	0.55		

Comfortable with treating lung		
No	1 [Reference]	N/A
Yes	0.63 (0.26-1.62)	0.35
Comfortable with treating breast		
No	1 [Reference]	N/A
Yes	0.91 (0.35-2.35)	0.85
Macho		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	2.09 (0.72-6.04)	0.17
Anti-authority		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.63 (0.13-3.08)	0.57
Worry		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.63 (0.19-2.08)	0.45
Resignation		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	1.01 (0.30-3.46)	0.98
Impulsivity		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.96 (0.31-2.95)	0.94
*OR = odds ratio		
†CI = confidence interval		
‡RO = radiation oncology		

Table 5. Univariable logistic regression analysis for variables potentially associated with compliance with *Choosing Wisely* scenarios among respondents. OR = Odds Ratio. CI = Confidence Interval. RO= Radiation Oncology

Variable	OR* (95% CI[†])	P
Age (years)		
≤50	1 [Reference]	N/A
>50	0.66 (0.20-2.18)	0.50
Gender		
Female	1 [Reference]	N/A
Male	1.60 (0.46-5.59)	0.46
Years since residency		
≤5	1 [Reference]	N/A
>5	0.37 (0.10-1.40)	0.14
Practice Setting[‡]		
Academic		
Other		
Number of patients on treatment		
<21	1 [Reference]	N/A
≥21	1.06 (0.27-4.18)	0.93
Number of RO[§] Colleagues		
0-10	1 [Reference]	N/A
>10	0.56 (0.18-1.75)	0.32

Macho		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.12 (0.03-0.40)	0.001
Anti-authority		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	1.83 (0.22-15.4)	0.58
Worry		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.68 (0.19-2.41)	0.55
Resignation		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.43 (0.17-1.57)	0.20
Impulsivity		
Bottom 3 quartiles	1 [Reference]	N/A
Top quartile	0.63 (0.18-2.26)	0.48

*OR = odds ratio

†CI = confidence interval

‡Too few observations for analysis.

§RO = radiation oncology