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Comparing Military and Civilian Dentists' Treatment Planning Decisions: Pilot Study

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Abstract

Research has been published on the variation in dentists' clinical decision-making. However, research examining differences in clinical decisions between public and private sector dentists has been limited and narrow in scope. With the military healthcare system being comprised of civilian and military providers, it is important to understand the potential differences in diagnosis, treatment planning, and the delivery of care. **Objective:** The purpose of this pilot study was to compare treatment planning recommendations between civilian and military providers. **Methods:** Patient level data from the 2018 Recruit Surveillance, a stratified, cross-sectional study of 1208 randomly selected US Air Force recruits, were used to evaluate treatment planning outcomes for the two provider groups (2 civilian; 7 military providers). Treatment planning outcomes included type of non-invasive, operative, and oral surgery treatment recommended, temporomandibular disorder referrals, and orthodontic referrals. Patient demographic variables included age, gender, education, race/ethnicity, and military component ("status"). Data was examined both at the tooth level and patient level for statistical significance. Multivariate analyses were performed with statistically significant variables included in each final model for patient-level data. Data were analyzed with logistic regression and Poisson regression ($\alpha=0.05$). Bivariate logistic regression analyses were performed for tooth-level data. **Results:** Significant differences were found between military and civilian dentists' treatment planning decisions ($p<0.05$) for both patient-level and tooth-level data. Adjusted for significant bivariate predictors of patient demographics at the patient level, civilian dentists were more likely to refer patients for orthodontic treatment, prescribe remineralization for sound tooth surfaces, incipient caries, and carious teeth, and prescribe direct restorations for teeth with 3-5 carious surfaces instead of single crowns compared to military dentists. Additionally, civilian dentists were less likely to prescribe sealants for sound tooth surfaces or carious teeth. No statistically significant difference in treatment planning outcomes was observed between civilian and military dentists for sealants for incipient caries, single crowns, or extraction of third molars. Analyzed at the tooth level, civilian dentists were more likely to prescribe remineralization for sound tooth surfaces, remineralization instead of sealants for carious surfaces, and extraction of third molars. No statistically significant differences were noted between civilian and military providers for recommending sealant or remineralization for teeth with incipient caries or prescribing single crown versus placing a direct restoration on posterior teeth with 3-5 carious surfaces. **Conclusions:** While a systematic

difference in aggressiveness of treatment plans did not emerge between military and civilian providers, this study does demonstrate that statistically significant differences in treatment planning outcomes between civilian and military providers exist and warrant further research.

Background

Considerable variation exists among dentists' diagnosis and treatment planning decisions. This became a matter of public outcry, eroding trust in the profession after the publication of the Reader's Digest article, "How Dentists Rip Us Off" in which a journalist visited 50 dentists and received 50 different opinions on diagnosis and treatment plans.¹ Patient trust is essential for garnering patients' full participation in restoring and maintaining their oral health. Practicing evidence based dentistry should produce greater consistency in clinical decision-making, promoting public trust and ensuring treatment recommendations are in the best interests of patients. Research over the past 30 years has attempted to illuminate non-clinical factors that influence dentists' clinical decisions.² To better understand the treatment planning process, Bader proposed an explanatory model to guide research on factors influencing dentists' clinical decision-making. The model includes three stages of treatment decision points: assessment, decision to treat, and treatment selection, with patient and dentist modifying factors.²

The first stage of Bader's model is the diagnostic phase. In this stage, there are often inter-dentist discrepancies identifying the extent of caries. Both intraoral exam and radiographs aid in accurate diagnosis of caries. In clinical exam scenarios, dentists utilize different clinical cues and parameters to assess suspicious lesions. In one study, these chosen clinical cues only accounted for 70% of the variation in diagnostic decisions.³ The question remains how dentists choose which cues to use and what factors account for the remaining differences. Additionally, even though high inter-dentist reliability has been demonstrated for radiographic diagnosis of caries, other factors such as the dentists' experience can impact the radiographic assessment of proximal lesions.⁴

The second stage of Bader's model is the decision to treat. Inter-dentist reliability for individual tooth recommendations was quantified in a study by Bader as moderate overall.⁵ Despite current recommendations for noninvasive treatment of enamel lesions, two systematic reviews found respectively that 5-88% and 21% of dental providers would surgically intervene for proximal enamel lesions and 4.6-17.8% and 12% for occlusal enamel lesions.^{6, 7} Research evaluating data from the National Dental Practice-Based Research Network observational study has shown the decision to invasively treat enamel lesions to vary based on both dentist and patient characteristics. Decisions to restore varied by patients' age and race/ethnicity as well as dentists' race/ethnicity, practice type and size, network region, and use of caries risk assessment.⁸⁻¹⁰ Dentists who did not assess caries risk and those in larger group practices (four or more practitioners) were more likely to surgically intervene for enamel lesions.^{8, 9} Additionally, other studies have found female dentists

and more recent graduates were more likely to delay invasive treatment of enamel lesions.^{11,12} A Japanese study found similar results, showing a significant association between patient and practice characteristics (patient age, type of practice, busyness of practice and percentage of patients who self-pay) and dentists' decisions to surgically treat enamel lesions.¹³

The third stage of Bader's model is treatment selection. Research indicates that non-clinical factors also influence treatment selection. A cross-sectional study of dentists in Ontario found dentists' age, number of dependents, perceived large loan sums, place of dental education, and practice size were associated with treatment intensity.¹⁴ An Australian study documented statistically significant correlations between dentists' practice preferences and beliefs, gender, and age as well as practice type and location on rates of types of dental treatments rendered.¹⁵ In the United States, one study showed variability in treatment planning single unit crowns based on type of practice, network regions, practice busyness, patient insurance status, and use of optical scanners, with a lack of consensus based on the size of existing restoration.¹⁶ Another study looking at recommendations for cuspal coverage found no statistically significant difference for treatment selection according to gender and experience.¹⁷ The three stages of Bader's model offer a structured framework for identifying and assessing potential sources of inconsistencies in clinical decision-making and subsequently developing targeted interventions to address these factors.

Unfortunately, research examining differences in clinical decisions between public and private sector is limited and narrow in scope, focusing on one aspect of treatment decisions. U.S. federal service dentists reported utilizing more minimal intervention dentistry than civilian dentists, but no other dental procedures were evaluated in the study.¹⁸ One Finnish study surveying public and private sector dentists found a statistically significant difference in implant therapy recommendations with private sector dentists being more likely to recommend implant therapy (57%) than public sector dentists (48%) for all questionnaire cases.¹⁹ While evidence from previous studies suggest that both practitioner and patient characteristics impact treatment recommendations, military versus civilian practice backgrounds as a potential factor influencing clinical decision-making have yet to be examined using the Bader model as a framework.

The purpose of this study was to compare dental treatment planning between civilian and military providers. Tooth-level and patient-level data from the 2018 Air Force Recruit Surveillance, a stratified, cross-sectional study of randomly selected US Air Force recruits, were used to evaluate both diagnoses and treatment planning outcomes for the two provider groups. Variables included independent diagnostic outcomes (coronal tooth structure codes and decayed, missing, or filled teeth (DMFT)) and dependent treatment planning outcomes (type of conservative treatment required, type of operative treatment required, third molar extraction, and orthodontics referrals). The study also examined if patient demographics, to include age, education, race/ethnicity, and military component affect treatment planning outcomes as a measure of implicit bias of the two provider groups. This study is relevant in an evolving military healthcare landscape to add to the discussion of potential ramifications for outsourcing dental care to the civilian sector. The null hypothesis was there will be no statistically significant difference between treatment planning outcomes for civilian and military providers.

Methods

The 2018 Air Force Recruit Oral Health Surveillance Study was designed to gather data on oral health status and dental treatment needs of Air Force recruits for readiness planning purposes.²⁰ Approximately 33,000 recruits enter the United States Air Force (USAF) annually. The recruits included in the study were randomly selected upon reporting for their in-processing dental screening. A random number generator was used to select 1,216 recruits for the study to achieve a statistical power of 80%, a margin of error of 4% and a 95% confidence interval. The selection process was specifically designed to account for recruits declining to participate. Near equal numbers of recruits were examined each month from February 2018 to January 2019 to avoid seasonal bias. Participant demographic data collected included: age, highest level of education (less than high school, high school graduate or equivalent, some technical school, some college, technical school graduate, college graduate (2-yr degree), college graduate (4-yr degree), beyond college (no degree), beyond college (with degree), no response), sex (male, female), race / ethnicity (White, Black, Asian, Hispanic, Other), and military component (Active Duty, Reserves, National Guard). Females, Reserve and Air National Guard recruits were oversampled to increase precision of population estimates in these groups. Weighting factors were service component and gender.

Two civilian dentists and seven military dentists served as clinical examiners for data collection during the course of the study. The two civilian dentists had no prior military experience. Prior to data collection, all examiners attended a 3-day calibration course.

Dentists conducted a comprehensive intraoral exam and reviewed panoramic and bitewing radiographs for each recruit participant. Clinical examination findings were recorded in a software program written specifically for the data collection. Oral pathology, temporomandibular dysfunction, malocclusion, removable prosthetic needs, edentulism, periodontal health, dental treatment needs and corresponding dental readiness class (DRC) were documented for each participant. Dentists did not examine the same patient. This study examined the differences in treatment planning based upon a given diagnosis rather than examining the act of diagnosing itself. Additionally, all dentists completed a specific 3-day didactic and clinical calibration training. Therefore, it was assumed that individual tooth diagnoses were accurate.

For this study, treatment planning outcomes (dependent variables) were gathered using both the tooth-level data and patient-level data from the 1,208 clinical exams. Patient-level data allowed for inclusion of patient demographics as possible factors correlating with treatment planning decisions. Tooth-level data were later included upon reflection on the nature of treatment planning in dentistry. Tooth-level diagnoses (independent variables) included caries status (sound, incipient or decayed), as well as impacted or unable to be scored for third molars. Tooth level and patient level treatment planning outcomes were: conservative treatment required (sealant or remineralization), operative treatment required 3-5 surfaces on posterior teeth or crowns on posterior teeth), oral surgery required for third molars (none or extraction), temporomandibular disorder referrals (none or referral, patient level only), and orthodontic referrals (none or referral, patient level only) (Table 1). Other independent variables consisted of examiner category (civilian or military) and patient demographics. The statistical analysis examined the association between examiner category (military or civilian) on the dependent variables, adjusted for participant demographic variables.

Table 1. Diagnostic and Treatment Planning Outcomes

Conditions		
Caries status		
Sound tooth	Incipient caries	Caries
Treatment Planning Outcomes		
Conservative Treatment Required		
Sealant	Remineralization	
Oral Surgery Required		
None	Simple + Complex + Impacted	
Operative Treatment Required		
3 + 4 + 5 surfaces posterior teeth	Crowns posterior teeth	
Temporomandibular Disorder Referrals (patient level data only)		
None	Referral	
Orthodontic Referrals (patient level data only)		
None	Referral	

After identifying the variables of interest, a data set was requested from and provided by the Tri-Service Center for Oral Health Studies (TSCOHS). TSCOHS sent a de-identified data set via a DoD-secured method to the Primary Investigator (PI) and the statistician.

Statistical Analysis

Bivariate regression and chi-squared analyses were performed with each patient demographic variable and each patient-level outcome variable of interest to identify significant independent variables, which subsequently were used to develop the most parsimonious models. Descriptive and inferential statistics were completed using logistic regression for dichotomous patient-level outcomes (e.g. orthodontic referral; TMD referral) and Poisson regression for categorical count outcomes (e.g., sealant vs remineralization; restorative vs. crown; third molar extraction vs. no extraction). Additionally, bivariate logistic regression was performed with tooth-level data; prescribed treatment regressed against provider status. An alpha level of 0.05 was used to determine significance.

Results

Two civilian dentists examined a total of 958 patients and seven military dentists examined a total of 250 patients for data collection during the course of the study (Table 1).

Patient demographic information was collected including education level, gender, race, age, and military status. A total of 46.89% of study participants had a high school education or less. Most participants were male (68.29%), white (59.69%), and active duty (50.17%) (Table 2).

All outcomes were examined at the patient level. The most frequent outcomes were extractions (673 patients), remineralization for sound tooth structure (621 patients) and remineralization for incipient caries (483 patients). The least frequent outcomes were sealants for incipient caries (3 patients), TMD referrals (4 patients), and single crowns (8 patients) (Table 3).

Statistically significant differences were found for multiple treatment planning outcomes for all patient demographic variables. Adjusted for significant bivariate predictors of patient demographics, civilian dentists were more likely to refer patients for orthodontic treatment, prescribe remineralization for sound tooth surfaces, surfaces with incipient caries, and carious teeth, and prescribe direct restorations for posterior teeth with 3-5 carious surfaces compared to military dentists. Additionally, civilian dentists were less likely to prescribe sealants for sound tooth surfaces or carious teeth. No statistically significant difference in treatment planning outcomes was observed between civilian and military dentists for single crowns, extraction of third molars, or sealants for teeth with incipient caries, (Table 4, 5). For the purposes of this study, oral surgery required (extraction vs. no treatment) pertained to sound, impacted or unable to be scored third molars only.

Table 2. Patient Demographics		
Characteristic	Civilian	Military
	(n = 958)	(n = 250)
Age, mean (SD)	21.41 (4.32)	20.65 (3.59)
Gender, n (%)		
Female	323 (33.72)	60 (24.00)
Male	635 (66.28)	190 (76.00)
Ethnicity/Race, n (%)		
White	538 (60.86)	138 (55.20)
Black	191 (19.94)	42 (16.80)
Asian	23 (2.40)	10 (4.00)
Hispanic	125 (13.05)	48 (19.20)
Other	36 (3.76)	12 (4.80)
Education, n (%)		
Less than or High School	431 (44.99)	135 (54.22)
Some technical/college or Tech school grad	375 (39.14)	88 (35.34)
College Grad (2 yr)	61 (6.37)	14 (5.62)
College Grad (4 yr) or beyond	91 (9.50)	12 (4.82)
Status, n (%)		
Active Duty	473 (49.37)	133 (53.20)
Reserves	238 (24.84)	53 (21.20)
National Guard	247 (25.78)	64 (25.60)

Table 3. Outcome and Total Frequency (Patients)		
Condition, Treatment plan	Total Frequency, # of Patients	Percent (%) of Patients
TMD, Referral	4	0.33
Orthodontic Malocclusion, Referral	184	15.31
Sound tooth, sealant	220	18.21
Sound tooth, remineralize	621	51.41
Incipient caries, sealant	3	0.25
Incipient caries, remineralization	483	39.98
Cariou teeth, sealants	46	3.81
Cariou teeth, remineralization	219	18.13
3-5 Cariou surfaces, direct restorations posterior	95	7.86
Single crowns	8	0.66
Extractions third molars	673	55.71

Condition, Treatment Plan	OR	CI
Temporomandibular Disorder, Referral	0.089	0.009 - 0.863
Orthodontic Malocclusion, Referral (adjusted for education)	2.7	1.6 – 4.40
Third Molars, Extraction	1.88	1.24 – 2.85

Provider Type More Likely to Recommend	Treatment Recommendation	Condition(s)	β	CI	Significant Variables Controlled For
Civilian	Remineralization	Sound tooth	0.664	0.491 - 0.838	Race
Civilian	Remineralization	Incipient caries	0.844	0.626 - 1.062	Gender, education, race
Civilian	Remineralization	Caries	0.812	0.461 - 1.163	Education, race
Military	Sealant	Sound tooth	-1.145	-1.322 - -0.968	Gender, status, age
N/A	Sealant	Incipient caries	-0.650	-3.051 - 1.750	None
Military	Sealant	Caries	-1.475	-1.918 - -1.032	Status, race
Civilian	Direct restoration	3-5 carious posterior surfaces	0.479	0.004 - 0.955	Status, race
N/A	Single crown	3-5 carious posterior surfaces	-1.061	-2.511 - 0.388	Education, race
N/A	Extraction	3 rd molar (impacted, sound or unable to be scored)	0.854	0.540 - 1.168	Education, status, race

Additionally, statistically significant differences were found for multiple treatment planning outcomes for tooth-level data. Analyzed at the tooth level, civilian dentists were more likely to prescribe remineralization for sound tooth surfaces, remineralization instead of sealants for carious surfaces, and extraction of third molars. No statistically significant differences were noted between civilian and military providers for recommending sealant or remineralization for teeth with incipient caries or prescribing single crown versus performing operative on posterior teeth with 3-5 carious surfaces. There was no difference between military and civilian providers regarding prescribing conservative treatment (remineralization or sealant) or operative for teeth with incipient caries. (Table 6).

Table 6. Treatment Plan Recommendations Based on Specific Conditions and the Provider Type Most Likely to Recommend Them – Odds Ratios, Tooth level data

Provider Type More Likely to Recommend	Treatment Recommendation	Condition(s)	OR	CI	n
Civilian	Remineralization instead of sealant	Sound tooth	5.87	0.13 – 0.22	1753
N/A	Remineralization or sealant	Incipient caries	4.29	0.02 – 2.59	933
N/A	Conservative treatment (remineralization/sealant) or direct restoration	Incipient caries	1.53	0.37 - 1.16	950
Civilian	Remineralization instead of sealant	Caries	10.56	0.54 – 0.17	427
N/A	Single crown or direct restoration	3-5 carious posterior surfaces	0.33	0.69 – 12.98	149
Civilian	Extraction	3 rd molar (impacted, sound or unable to be scored)	2.08	0.35 – 0.66	2372

Discussion

Originally the data from this study were analyzed at the patient level. This allowed inclusion of patient demographics as possible factors correlating with treatment planning decisions. However, tooth-level data analysis was later analyzed upon reflection on the nature of treatment planning in dentistry. Each tooth is diagnosed individually and therefore treatment planned as a separate entity. For example, the treatment plan for a maxillary left molar does not automatically impact the treatment decision for the contralateral molar. The treatment planning outcomes that do not follow this same process and are not tooth specific are orthodontic and TMD referrals, thus not subject to being analyzed at the tooth-level. All of the trends except two remained unchanged between the two data analyses. At the tooth level, there was not a statistically significant difference between civilian and military providers recommending remineralization or sealants for incipient caries. Additionally for tooth-level analysis, civilians were statistically significantly more likely to prescribe extraction of impacted, sound, or unable to be scored third molars. An additional treatment outcome variable was created for tooth-level analysis to address conservative treatment planning decisions more directly. Remineralization and sealants were combined as non-invasive conservative treatment for incipient caries. This study found no difference between military and civilian providers regarding prescribing conservative treatment (remineralization or sealant) or direct restorations for teeth with incipient caries.

The first stage of Bader’s model is the diagnostic phase. In this stage, Bader describes inter-dentist discrepancies identifying the extent of caries. For this study, all examiners attended a 3-day

calibration course focused on diagnostic criteria and proper documentation prior to data collection. Therefore, it was assumed inter-dentist diagnostic discrepancies were negligible for this study.

The second stage of Bader's model is the decision to treat. This study examined non-surgical interventions for sound tooth structure (no caries), incipient caries, and carious lesions prescribed by both types of providers. Civilian providers were statistically significantly more likely to prescribe the non-surgical intervention of remineralization for incipient caries and carious lesions compared to military dentists in the patient-level data. This may contradict a concern that civilian providers would be more aggressive and prescribe more surgical interventions than their military counterparts. However, when examined at the tooth-level, there was no difference between remineralization or sealants between the two provider groups for incipient lesions. The difference only remained that civilians were more likely to prescribe remineralization instead sealants for carious teeth compared to military providers.

Civilian providers were also more likely to prescribe remineralization, defined as "application of topical medicament to a demineralized surface", for surfaces diagnosed as sound tooth structure. This trend was also seen in the tooth-level data analysis. By definition, sound tooth structure is not demineralized and therefore should not require remineralization. Remineralization of sound tooth structure was not an expected treatment planning outcome. Sound tooth structure was primarily included in the data with the expectation that these surfaces would be the most likely diagnosis for prescription of sealants. Rather than overtreatment, prescription of remineralization for sound tooth structure may be indicative of a knowledge gap between civilian and military providers since remineralization techniques are promoted in military dentistry as effective conservative treatment strategies for lesions limited to the outer one third of the dentin.

Military providers were more likely to prescribe sealants for sound tooth structure or carious lesions than civilian dentists. There was no statistically significant difference between the civilian and military providers for prescription of sealants for incipient caries. There was no statistically significant difference between military and civilian providers regarding prescribing conservative treatment (remineralization or sealant) or direct restorations for teeth with incipient caries. In the military setting, annual dental exams are a requirement to continually assess military readiness. Therefore, in this setting dentists can be confident that patients will be followed at least annually, which may predispose providers treating this population to prescribe non-surgical therapy.

Other studies have found that decisions to restore varied by patients' age and race/ethnicity.⁸⁻¹⁰ Gender, education, race, military status, and age were significant predictors, correlated with likelihood of decision to treat. For example, Black study participants were more likely to be prescribed remineralization for all tooth conditions (sound, incipient, carious) compared to other races. Reservists were less likely to be prescribed a sealant for sound or decayed tooth structure than Active Duty or Guard members. Active Duty members, younger participants, and those with 2 years of college education or less were more likely to be prescribed extractions of third molars. Education level attainment and age are expected to be correlated. Providers may be more likely to refer Active Duty members for third molar extractions compared to other military status participants because of a desire to minimize the possibility of third molar complications later during a member's service being worth the time away from their current duty. This supports the

emphasis military providers are required to place on medical readiness, resulting in the preemptive removal of potentially problematic third molars. Patient demographic factors may be directly related to diagnosed tooth conditions not implicitly influencing provider treatment decisions. The correlations found in this study support the need for further research examining patient demographics and treatment planning outcomes.

Civilian providers in this study were two times more likely to refer a patient for orthodontics than military providers, (OR = 2.7, CI = 1.6 – 4.4). This again may reflect the emphasis on medical readiness that military providers must uphold, understanding that orthodontic treatment is reserved for cases where developmental and skeletal deficiencies or tooth alignment compromise dental readiness. It may also suggest other factors that influence treatment planning decisions, including military providers' awareness of the limited availability of military orthodontic resources. Education remained significant where members with a high school education or less were 2.5 times more likely to be referred for orthodontics than those with a 4-year college degree or higher. The correlation with education may be confounded by age and socioeconomic factors, but this information could not be determined from this study's data.

The third stage of Bader's model is treatment selection. This study examined the treatment selection differences for posterior teeth with 3-5 carious surfaces between direct operative restorations versus single crowns. Civilian providers were more likely to prescribe operative procedures for teeth with 3-5 surfaces of caries than military providers, but there was no statistically significant difference between civilian providers and military providers for prescription of single crowns. These results do not indicate either provider group exhibits a propensity for aggressive treatment when compared to each other.

Despite the large sample size (1208), some prescribed procedures exhibited low frequency. For example, civilian providers were less likely to refer a patient for TMD than military providers, (OR = 0.089, CI = 0.009 - 0.863). However, given the exceptionally low number referred in total (4 out of 1208), this finding is not clinically meaningful. Additionally, only eight patients were prescribed single crowns. This decreases the strength of the conclusion that can be made from the results that there was no statistically significant difference between civilian providers and military providers for prescription of single crowns.

The original purpose of data collection was not designed for a clinical decision-making analysis. Therefore, some data such as demographic information of providers beyond military or civilian could not be reliably matched and included in patient-level analyses. Previous studies have indicated provider demographic characteristics can affect clinical decisions, therefore, further research expounding upon this pilot study should include and adjust for additional provider demographics in analysis such as age, gender, race, and years of experience. However, an advantage of using this data was that providers were not aware that their treatment planning decisions would be evaluated, eliminating a potential source of bias during data collection.

There were statistically significant differences in treatment planning decisions. However, a systematic difference in aggressiveness of treatment plans did not emerge between military and civilian providers. While this was a pilot study with a limited number of providers, this

demonstrates lack of clear evidence for either provider type regularly prescribing overtreatment in an Air Force dental treatment facility. Ideally in future studies, the same patients would be examined by both a civilian and military provider for direct comparison. The providers prescribing treatment were not the ones to render treatment in this study. In a real-world setting, where prescribing providers are responsible for completing treatment for compensation, more aggressive or profitable treatment may have been prescribed or personal provider preference for clinical treatment may have influenced the treatment planning phase. One argument against utilizing civilian providers for military members' dental needs is fear of overtreatment for financial gain and suboptimal financial stewardship. Further research is warranted with more providers to examine the effect of responsibility for rendering treatment and compensation considerations on clinical decision-making, especially when the civilian providers are outside of the military setting.

Conclusions

Statistically significant differences were found for multiple treatment planning outcomes for all patient demographic variables. Patient demographic factors in this study were also correlated with likelihood of prescription of certain treatments. A systematic difference in aggressiveness of treatment plans did not emerge between military and civilian providers, but this study demonstrates that differences in treatment planning outcomes between civilian and military providers do exist and warrant further research beyond this pilot study.

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