



2022 EMS Professionals Reading List

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EXECUTIVE SUMMARY

Introduction

Influenced by publications such as the National EMS Research Agenda and the Institute of Medicine “EMS at the Crossroads,” there has been a decades-long effort to incorporate more scientific evidence into EMS personnel education and EMS clinical protocols. Efforts of the National Registry of EMTs (NREMT) and the Prehospital Guidelines Consortium (PGC) have aimed to improve the dissemination of new scientific knowledge among EMS clinicians, including through improved education about EMS research and evidence-based guidelines.

Objective

Through a collaborative agreement with the NREMT, the PGC aimed to identify and report top recent published scientific peer-reviewed articles that could be incorporated into certification and continued competency activities for EMS clinicians.

Methods

The PGC established an open call for scientific literature of relevance to EMS clinicians published between 2019 and 2021. The open call was disseminated by EMS stakeholder organizations comprising the PGC. Submissions were categorized using the NREMT Table of Evidence Framework. Submitted publications were reviewed and scored using a 1-5 Likert scale. Through additional review by members of the Research and Development Committees of the PGC, a list of top 10 articles was selected and recommended by the PGC Board of Directors.

Results

There were 63 submissions, of which 58 unique publications met the inclusion criteria. Submissions included published original research, systematic reviews, position statements and non-peer reviewed sources, such as textbook chapters and blogs. Most submissions were retrospective analyses (59%). Most submissions were categorized as primary research with a level of evidence rating of “B-II” using the NREMT Types of Evidence Framework. All three “types of evidence” were represented, and 6 “quality of evidence” level A sources were submitted. Submissions were rated by 12 EMS stakeholder representatives. The range of average Likert rating for all submissions was 1.5-4.75. A final list of 10 articles, all receiving average ratings ≥ 4 were selected and supported by the PGC Board of Directors as recommended articles for EMS professionals.

Conclusions

Ten articles published between 2019 and 2021 are reported as important publications that may support certification and continued competency activities for EMS clinicians. These articles comprise randomized clinical trials, large cohort studies, position or consensus statements, and a systematic review of prehospital evidence-based guidelines.

INTRODUCTION

In 2001, the National EMS Research Agenda identified a need for more scientific evidence to guide prehospital care (1). Similarly, in 2007, the Institute of Medicine (now the National Academies of Medicine) called upon the EMS community to incorporate more scientific evidence in EMS protocols (2). Over the past several decades, the scientific basis guiding EMS medicine has grown substantially and in 2013, EMS medicine was recognized as a separate clinical subspecialty by the American Board of Emergency Medicine and the American Board of Medical Specialties (3).

In 2015, the National Association of EMS Physicians (NAEMSP) completed a 2-year cooperative agreement with the National Highway Traffic Safety Administration (NHTSA), with supplemental funding from the EMS For Children program of the Health Resources and Services Administration (HRSA), to develop a National Prehospital Evidence-Based Guidelines Strategy (4). Key action items from this Strategy included promoting research that supports creation and evaluates the impact of EMS medicine and related evidence-based guidelines, as well as promoting education of EMS personnel and dissemination of new knowledge related to EMS research and evidence-based guidelines. A core component of the Strategy aimed to facilitate these actions was the creation of the Prehospital Guidelines Consortium (PGC), a representative organization now comprised of 36 stakeholder organizations with interest in EMS medicine who aim to collaborate in the development, implementation, and evaluation of evidence-based guidelines along with these actions of the National Prehospital EBG Strategy.

In 2016, the National Registry of EMTs (NREMT) published updated guidance for its National Continued Competency Program (NCCP) to encourage Nationally Certified EMS personnel to pursue life-long education (5). A core component of the NCCP highlighted the need for education in EMS research and evidence-based guidelines for Nationally Certified EMS personnel. This is consistent with the recommendations of multiple stakeholder organizations to promote the dissemination of scientific evidence and incorporation of this evidence into education provided directly to EMS personnel (4). Consistent with these interests and efforts, the NREMT and PGC formed a collaborative agreement in 2021 to identify the newest prehospital EBGs, rated by their quality of evidence, along with a list of primary scientific literature that would be of value for incorporation into initial certification and continued competency activities (the “EMS Professionals Reading List”).

We herein report the development and results of the 2022 EMS Professionals Reading List. For this project, we aimed to engage the EMS community represented in the Prehospital Guidelines Consortium to identify key peer-reviewed scientific literature that are recommended for incorporation in certification activities for EMS personnel. Informed by a panel of stakeholder representatives from the PGC, the product of this effort is a list of top articles endorsed by the PGC as key scientific literature of value to EMS educational activities.

METHODS

To facilitate the identification of high-quality peer-reviewed literature of relevance to EMS personnel, the PGC established an open call for members of PGC-affiliated organizations to submit articles published between 2019 and 2021 that should be considered for future certification activities for EMS professionals. Suggested article types included peer-reviewed research studies, systematic reviews, or narrative reviews of the literature. The open call was communicated through the PGC to its member organizations and distributed by those member organizations through their internal communications (e.g., newsletters and emails). The open call was published, and articles could be submitted through the PGC's website (www.prehospitalguidelines.org).

The open call for articles was supplemented by discussion and further submissions obtained during the annual meeting of the PGC on January 14, 2022, attended by 29 stakeholder representatives. The final list of submitted articles was reviewed by members of the PGC's Research Committee and Development Committee, supplemented by additional representatives from the PGC. Submissions were classified by type of article and categorized using the NREMT Types of Evidence Framework (Table 1). A total of 12 stakeholders were then engaged to rate the submissions for overall importance using a 1-5 Likert scale, as well as to identify their suggested "top submissions" or any articles recommended for exclusion.

The results of the Research and Development Committee's survey were presented to members of the PGC on July 5, 2022. Ratings were stratified to reach consensus on the classification of the top articles that should be submitted to the NREMT. The PGC Board of Directors reviewed the list of top articles on July 12, 2022 and supports their incorporation in educational and continued competency activities for EMS personnel.

RESULTS

A total of 63 submissions were obtained from the open call for publications. Five were excluded, including 3 submissions that were duplicate, one submission that was out of the date range, and one was a clearinghouse website (6) that was excluded for being out of scope of the type of materials included (i.e., primary scientific publication). Therefore, 58 unique submissions were considered for review by 12 stakeholder representatives from the PGC. Types of primary source material included published original research, systematic reviews, and non-peer reviewed sources, such as textbook chapters and blogs (Table 2). Most submissions were retrospective analyses (58.6%). Using the NREMT Types of Evidence Framework, most were categorized as primary research with a level of evidence rating of "B-II," however, all three "types of evidence" were included, and 6 "quality of evidence" level A sources were submitted. Nine (15.5%) submissions were specifically related to COVID-19.

In the expert rating phase, 11 panel members rated all 58 submissions. One panel member rated only recommended publications. The range for average Likert rating for all submissions was 1.5-4.75. At least one expert identified a source as “do not include” for 11 of the submissions. Using the average Likert ratings, a final list of 10 publications were selected for inclusion as top recommended publications for EMS professionals (Table 3). Eight of the selected publications were primary research articles and two were documents focused on recommendations for care (Table 4). All articles in the final list received average ratings of ≥ 4 ; the average Likert rating and the number of respondents that identified each submission as being the “top paper” are reported in Table 5. No publications in the final list were identified as “do not include.”

DISCUSSION

We herein provide a summary of the top articles identified for the EMS Professionals Reading List.

Berry et al. EMS Agencies with High Rates of Field Termination of Resuscitation and Longer Scene Times Also Have High Rates of Survival (7)

Berry et al. obtained data from the Cardiac Arrest Registry to Enhance Survival (CARES) to evaluate if EMS agencies with greater average time on-scene and higher rates of field termination of resuscitation would have more favorable outcomes. After identifying out-of-hospital cardiac arrest (OHCA) cases from 2013 to 2018, they classified 95 agencies into high on-scene time (HiOST, average >25.1 min) and low on-scene time (LoOST, average <19.3 min) as the top and bottom quartiles. Controlling for agency characteristics, HiOST had a higher survival to discharge for transported patients (28.1% vs 23.1%, OR 2.8, 95%CI 2.1–3.6, $P < 0.001$), ROSC on emergency department arrival, and favorable neurologic outcome than LoOST. HiTOR had a higher survival to discharge for transported patients (25.6% vs 19.3%, OR 3.3, 95 %CI 2.5–4.4, $P < 0.001$), ROSC on emergency department arrival, and favorable neurologic outcome than LoTOR. This study highlights that EMS agencies with higher rates of on-scene resuscitation for OHCA have higher overall patient survival, ROSC, and favorable neurological function.

Grunau et al. Association of Intra-arrest Transport vs Continued On-Scene Resuscitation with Survival to Hospital Discharge Among Patients with Out-of-Hospital Cardiac Arrest (8)

Grunau et al. performed a prospective cohort study of nontraumatic adult EMS-treated OHCA patients from the Resuscitation Outcomes Consortium registry. They matched and compared patients treated with intra-arrest transport with patients in refractory arrest without transport using a time-dependent propensity score to evaluate survival to hospital discharge and

survival with favorable neurological outcome at hospital discharge. A cohort of 43,969 patients were included, of which 27,705 patients comprised the propensity-matched cohort. Survival to hospital discharge was 3.8% versus 12.6% for patients who did or did not undergo intra-arrest transport, respectively. In the propensity-matched cohort, survival to hospital discharge occurred in 4.0% vs 8.5% of patients who did or did not undergo intra-arrest transport, respectively (risk difference, 4.6% [95%CI, 4.0%-5.1%]). Favorable neurological outcome occurred in 2.9% versus 7.1% of patients who did or did not undergo intra-arrest transport, respectively (risk difference, 4.2% [95%CI, 3.5%-4.9%]). This study highlights that patients undergoing intra-arrest transport to the hospital compared to continued on-scene resuscitation were associated with lower probability of survival to hospital discharge.

Guyette et al. Tranexamic Acid During Prehospital Transport in Patients at Risk for Hemorrhage After Injury: A Double-blind, Placebo-Controlled, Randomized Clinical Trial (9)

Guyette et al. performed a multicenter, double-blind, placebo-controlled, superiority randomized clinical trial of 927 prehospital trauma patients with hypotension (systolic blood pressure ≤ 90 mmHg) or tachycardia (heart rate ≥ 110 /min) before arrival at 1 of 4 US level 1 trauma centers, within an estimated 2 hours of injury. Patients were randomized to receive 1 g of tranexamic acid before hospitalization or placebo. A non-significant decrease in mortality at 30 days was found in patients receiving tranexamic acid compared to placebo (8.1% versus 9.9%; difference, -1.8%; 95%CI, -5.6% to 1.9%; $p=0.17$). However, in pre-planned subgroup analyses, 30-day mortality was lower when tranexamic acid was administered within 1 hour of injury (4.6% vs 7.6%; difference, -3.0%; 95%CI, -5.7% to -0.3%; $p<0.002$) and in patients with severe shock (systolic blood pressure ≤ 70 mmHg) (18.5%vs 35.5%; difference, -17%; 95%CI, -25.8% to -8.1%; $p<0.003$). Administration did not result in a higher incidence of thrombotic complications or adverse events. In summary, while use of tranexamic acid before hospitalization in injured patients at risk of hemorrhage did not result in significant lower 30-day mortality, it was demonstrated to be beneficial in the subgroups treated within 1 hour of injury or with severe shock.

Jauch et al. Recommendations for Regional Stroke Destination Plans in Rural, Suburban, and Urban Communities From the Prehospital Stroke System of Care Consensus Conference: A Consensus Statement From the American Academy of Neurology, American Heart Association/American Stroke Association, American Society of Neuroradiology, National Association of EMS Physicians, National Association of State EMS Officials, Society of NeuroInterventional Surgery, and Society of Vascular and Interventional Neurology: Endorsed by the Neurocritical Care Society (10)

Jauch et al. report a consensus statement on behalf of the Prehospital Stroke Systems of Care Consensus Conference, comprised of leading national experts in prehospital acute stroke care, that was convened at the AHA/ASA International Stroke Conference in January 2018. This

statement reviews the current accreditation and certification of health care facilities relevant to the care of acute stroke patients and their distribution across the United States. Three working groups from this consensus panel were established to evaluate and report on specific considerations for the care of prehospital stroke patients in urban, suburban, and rural settings. Common principles for care of stroke patients across settings are provided and include establishing destination plans, engaging in public education, utilizing 911 stroke screening, integration of EMS into hospital systems of care, and use of evidence-based stroke care. Specific considerations and recommendations are outlined for urban, suburban, and rural areas highlighting common differences and challenges among these settings relevant to available prehospital care and health care facilities. Specific recommendations tailored to each of these EMS system communities are provided. In sum, this consensus statement provides concrete recommendations for enhancing stroke care across various EMS settings with consideration of the latest available hospital-based resources for acute stroke care.

Lemkes et al. Coronary Angiography After Cardiac Arrest Without ST-segment Elevation (11)

Lemkes et al. performed a multicenter, randomized controlled trial of 552 patients who had cardiac arrest without signs of ST-elevation myocardial infarction (STEMI) to undergo immediate or delayed (until neurological recovery) coronary angiography. The primary and secondary outcomes were survival at 90 days and survival at 90 days with good cerebral performance or mild or moderate disability, myocardial injury, duration of catecholamine support, markers of shock, recurrence of ventricular tachycardia, duration of mechanical ventilation, major bleeding, occurrence of acute kidney injury, need for renal-replacement therapy, time to target temperature, and neurologic status at discharge from the intensive care unit. At 90 days, 64.5% versus 67.2% of the delayed angiography group were alive (OR 0.89, 95% CI 0.62-1.27, $p=0.51$). There were no significant differences between the groups in the secondary end points. This study identified that among patients who had been resuscitated after OHCA and have no signs of STEMI, a strategy of immediate angiography was not better than delayed angiography with respect to overall survival at 90 days.

Morgan et al. Ketamine Use in Prehospital and Hospital Treatment of The Acute Trauma Patient: A Joint Position Statement (12)

Morgan et al. report a joint position statement on the use of ketamine in prehospital and hospital treatment of the acute trauma patient on behalf of the American College of Surgeons Committee on Trauma (ACS-COT), the American College of Emergency Physicians (ACEP), the National Association of State EMS Officials (NASEMSO), the National Association of EMS Physicians (NAEMSP) and the National Association of EMTs (NAEMT). This position statement identifies appropriate indications for use of ketamine in trauma patients, contraindications, and considerations for dosing and safety. Potential complications and side effects are reviewed, along with specific considerations for use of ketamine in patients with head

and eye injuries. Use in combination with other drugs, including non-prescribed drugs, is also reviewed. Finally, special considerations for geriatric and pediatric patients are included. This consensus overall outlines the role and key considerations for use of ketamine in prehospital and in-hospital trauma patients.

Spaite et al. Association of Statewide Implementation of the Prehospital Traumatic Brain Injury Treatment Guidelines with Patient Survival Following Traumatic Brain Injury: The Excellence in Prehospital Injury Care (EPIC) Study (13)

Spaite et al. evaluated implementation of the Excellence in Prehospital Injury Care (EPIC) Study prehospital traumatic brain injury (TBI) guidelines across more than 130 EMS agencies throughout Arizona. These guidelines emphasize avoidance/treatment of hypoxia, prevention/correction of hyperventilation, and avoidance/treatment of hypotension. There were 21,852 patients that met inclusion criteria for analysis. Comparison of the post-implementation versus pre-implementation phases revealed an adjusted odds ratio (aOR) of 1.06 (95%CI, 0.93-1.21; P=0.40) for survival to hospital discharge. The aOR was 1.70 (95%CI, 1.38-2.09; p<0.001) for survival to hospital admission. Among the severe injury cohorts (but not moderate or critical), guideline implementation was significantly associated with survival to discharge (Regional Severity Score–Head 3-4: aOR, 2.03; 95%CI, 1.52-2.72; p<0.001; Injury Severity Score 16-24: aOR, 1.61; 95%CI, 1.07-2.48; P=0.02). This was also true for survival to discharge among the severe, intubated subgroups (Regional Severity Score–Head 3-4: aOR, 3.14; 95%CI, 1.65-5.98; p<0.001; Injury Severity Score 16-24: aOR, 3.28; 95%CI, 1.19-11.34; p=0.02). This study highlights the potential positive impact of implementation of the EPIC TBI guidelines on survival to hospital discharge for patients with severe TBI.

Turner et al. Systematic Review of Evidence-Based Guidelines for Prehospital Care (14)

Turner et al. report the first systematic review of prehospital evidence-based guidelines by the Prehospital Guidelines Consortium. This systematic review identified all existing evidence-based guidelines relevant to prehospital care since inception of several scientific databases through September 2018. A total of 71 evidence-based guidelines were identified and the quality of their evidence evaluation was graded using the Appraisal of Guidelines for Research and Evaluation (AGREE) II tool. Guidelines were also categorized based on meeting the National Academy of Medicine (NAM) criteria for high-quality guidelines. This review identified only 38% of guidelines met all NAM criteria for high-quality guidelines and 9 scored >75% across AGREE II domains. This systematic review provides the first aggregate report of existing prehospital EBGs and highlights key high-quality guidelines that were published prior to September 2018.

This work has since been supplemented by a second systematic review completed for guidelines published between 2018 through mid-2021, reported separately as part of the collaborative agreement between the PGC and NREMT.

Vigil et al. Death by Suicide-The EMS Profession Compared to the General Public (15)

Vigil et al. highlight that in 2016, nearly 45,000 deaths in the United States were attributed to suicide, making this the 10th leading cause of death for all ages and that national survey data suggests that EMS personnel (firefighters, EMTs, and paramedics) may have higher rates of suicide compared to the general public. This study aimed to determine the statewide Mortality Odds Ratio (MOR) of suicide completion among EMS personnel compared to non-EMS personnel in Arizona. In a 7-year analysis (2009-2015) of the Arizona Vital Statistics Information Management System Electronic Death Registry for adult deaths, EMS occupation was determined by manual review. A total of 7,838 of 350,998 deaths were categorized as suicide; 5.2% of deaths were attributable to suicide among EMS personnel versus 2.2% among non-EMS personnel ($p < 0.001$). After adjusting for gender, age, race, and ethnicity, EMS personnel had higher odds of death by suicide compared to the general public (aMOR 1.39, 95%CI 1.06–1.82). This study highlights a significantly higher Mortality Odds Ratio among EMS personnel compared to the general public and the need for future research and effective prevention strategies to address the underlying causes of suicide among EMS personnel.

Watanabe et al. Is Use of Warning Lights and Sirens Associated with Increased Risk of Ambulance Crashes? A Contemporary Analysis Using National EMS Information System (NEMSIS) Data (16)

Watanabe et al. performed a retrospective cohort study using the 2016 National EMS Information System data set to identify 911 scene responses and subsequent patient transports by transport-capable EMS units. They calculated the rate of crash-related delays per 100,000 responses or transports and used multivariable logistic regression to evaluate the association between crash-related delays and lights and siren use for responses and transports. Among 19 million 911 scene responses, the study identified a higher rate of crashes during responses with lights and siren use (5.4 per 100,000) versus without lights and siren use (4.6 per 100,000; AOR 1.5, 95%CI 1.2-1.9). Similarly, there was a higher rate of crashes during transport with lights and siren use (17.1 per 100,000) versus without lights and siren use (7.0 per 100,000; AOR 2.9, 95%CI 2.2-3.9). This large nationally representative study identified an increased risk of ambulance crashes in both the response and transport phases with use of lights and siren and highlights the need to weight these risks against the potential time savings associated with lights and siren use.

CONCLUSIONS

This working group from the Prehospital Guidelines Consortium identified 10 peer-reviewed publications of high importance for the education of EMS clinicians. Identified through an open call among EMS stakeholder organizations and based on rankings from representatives of EMS stakeholder groups, this literature list may serve as important content for certification and continued competency activities. The included literature comprises publications of randomized controlled trials, impactful position and consensus statements, large cohort studies of key EMS topics, and a systematic review of prehospital evidence-based guidelines.

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Table 1. NREMT Table of Evidence Framework

Quality of Evidence	Types of Evidence			Impact on Initial Certification Examination	
	Recommendations for Care	Primary Research	Informational or Educational Content		
A	Evidence-based guidelines (meet NAM criteria)	Systematic Review Meta-analysis Randomized controlled study (blinded or other)		Ensure items are consistent with level A Level A evidence should prompt immediate review of live items	
B	I	Regulatory standards Legal Briefs / court opinion Government standards		Ensure exam items are consistent with level B-I, B-II. Standard item development timelines are sufficient	
	II	National Model clinical guidelines Position statements Evidence-based guidelines (not meet NAM criteria)	Retrospective analysis Quasi-randomized trials Observational study	Education standards Structured training courses	Ensure exam items are consistent with level B-I, B-II. Standard item development timelines are sufficient
	III	Best Practice Documents Technical Reports		Textbooks	Ensure items are supported by multiple documents / references
C		Case series or reports	Expert opinion Expert lecture Informal crowd source projects Blogs / podcasts	Evidence at this level is not appropriate for examination content	

*Adapted from Terry M, McKenna KD, Powell JR, Hollern M, Ozanich M, Richards CT, Martin-Gill C, Panchal AR. Systematic Framework for Prioritizing and Incorporating Prehospital Evidence Into Competency Assessments. Prehosp Emerg Care. 2022;26(1):146.

Table 2 – Characteristics of Submissions Categorized by the NREMT Table of Evidence Framework

Quality of Evidence	Types of Evidence			Total
	Recommendations for Care	Primary Research	Informational or Educational Content	
A	0 (0%)	6 (10.3%)	0 (0%)	6 (10.3%)
B	I	0 (0%)	0 (0%)	0 (0%)
	II	2 (3.5%)	43 (74.1%)	45 (77.6%)
	III	4 (6.9%)	0 (0%)	2 (3.5%)
C	0 (0%)	0 (0%)	1 (1.7%)	1 (1.7%)
Total	6 (10.3%)	49 (84.5%)	3 (5.2%)	58 (100%)

Table 3 – Recommended Reading List for EMS Professionals

Authors	Title	Journal	Type of Article
Berry et al. (7)	EMS agencies with high rates of field termination of resuscitation and longer scene times also have high rates of survival	Resuscitation	Original Research
Grunau et al. (8)	Association of Intra-arrest Transport vs Continued On-Scene Resuscitation With Survival to Hospital Discharge Among Patients With Out-of-Hospital Cardiac Arrest	JAMA (Open Source)	Original Research
Guyette et al. (9)	Tranexamic Acid During Prehospital Transport in Patients at Risk for Hemorrhage After Injury: A Double-blind, Placebo-Controlled, Randomized Clinical Trial	JAMA Surg (Open Source)	Original Research
Jauch et al. (10)	Recommendations for Regional Stroke Destination Plans in Rural, Suburban, and Urban Communities	Stroke (Open Source)	Guidance Document
Lemkes et al. (11)	Coronary angiography after cardiac arrest without ST-segment elevation	N Engl J Med (Open Source)	Original Research
Morgan et al. (12)	Ketamine use in prehospital and hospital treatment of the acute trauma patient: a joint position statement	Prehosp Emerg Care (Open Source)	Position Statement
Spaite et al. (13)	Association of Statewide Implementation of the Prehospital Traumatic Brain Injury Treatment Guidelines With Patient Survival Following Traumatic Brain Injury: The Excellence in Prehospital Injury Care (EPIC) Study	JAMA Surg (Open Source)	Original Research
Turner et al.(14)	Systematic Review of Evidence-Based Guidelines for Prehospital Care	Prehosp Emerg Care	Systematic Review
Vigil et al. (15)	Death by Suicide-The EMS Profession Compared to the General Public	Prehosp Emerg Care	Original Research
Watanabe et al. (16)	Is use of warning lights and sirens associated with increased risk of ambulance crashes? A contemporary analysis using National EMS Information System (NEMSIS) data	Ann Emerg Med	Original Research

Table 4 – Characteristics of the Highest Rated Submissions Based on the NREMT Table of Evidence Framework

Quality of Evidence	Types of Evidence			Total
	Recommendations for Care	Primary Research	Informational or Educational Content	
A	0 (0%)	3 (30%)	0 (0%)	3 (30%)
B	I	0 (0%)	0 (0%)	0 (0%)
	II	1 (10%)	5 (50%)	6 (60%)
	III	1 (10%)	0 (0%)	1 (10%)
C	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	2 (20%)	8 (80%)	0 (0%)	10 (100%)

Table 5. Ratings of the Highest Rated Submissions

Source	Avg rating	Top paper
Grunau et al.	4.75	3
Berry et al.	4.71	1
Jauch et al.	4.63	2
Spaite et al.	4.57	0
Guyette et al.	4.50	1
Vigil et al.	4.44	1
Watanabe et al.	4.43	2
Morgan et al.	4.14	0
Turner et al.	4.00	1
Lemkes et al.	4.00	0