Review Article

A scoping review of successful strategies for passing the American Board of Surgery certifying examination

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A R T I C L E   I N F O

A B S T R A C T

Background: This scoping review identifies existing literature that investigates what factors contribute to success on the American Board of Surgery (ABS) Certifying Exam (CE) to provide practical, evidence-based recommendations.
Methods: A Pubmed search was completed utilizing the preferred reporting items for systematic reviews and meta-analysis extension for scoping review (PRISMA-ScR) method.
Results: Of 4368 articles identified, 45 articles met criteria for review. Manuscripts were placed into one of five categories: predictors from medical school, program interventions, modifiable candidate factors, the effect of mock oral exams, and those factors shown not to provide benefit for CE preparation.
Conclusions: A variety of factors have either been shown to provide benefit for or be predictive of CE performance. Acknowledgement of these factors can provide benefit to both surgery residents as well as surgery programs. Despite these findings, research into these factors is generally of low quality, prompting the need for ongoing, high-quality investigations.

Introduction

American Board of Surgery (ABS) certification represents and invaluable milestone for early career surgeons, signifying their proficiency and dedication to the surgical discipline. Recognized as the gold standard in the United States, ABS certification is a testament to a surgeon's caliber, considered as a marker of quality, and often required by employers to practice surgery. This perception is not without merit, as non-certified surgeons have been found to be associated with a higher incidence of operative complications [1] and an elevated risk for disciplinary action [2]. Therefore, it is important for residency programs to develop successful strategies to facilitate trainees' preparation for the ABS Certifying Examination.

The process of obtaining board certification entails a two-step examination system. First, candidates must pass the Qualifying Examination (QE), a written test featuring a standard multiple-choice format aimed at assessing the breadth of their medical knowledge. This is followed by the Certifying Examination (CE), an oral examination aimed at evaluating a candidate's clinical skills and ability to use medical knowledge to appropriately manage surgical patients.

The CE represents a unique challenge for trainees, deviating from the format of most conventional examinations they have faced though medical school and residency. The CE encompasses twelve scenarios, representing the breadth of general surgery, presented in oral form by pairs of examiners, with approximately seven minutes allotted to each scenario. In order to pass, the candidate must utilize their accumulated medical knowledge, coupled with rapid clinical decision making. There is some degree of overlap between passing the QE and CE, with the Board itself finding a modest correlation between the two exams [3]. However, to pass the CE, candidates need to demonstrate an organized approach to the diagnosis and management of common surgical conditions. There are multiple reasons that residency programs may lack a

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standardized approach to CE preparation, such as the exam's unique format as well as the significant commitment, required by both faculty and resident participants.

Consequently, the objective of this review is to:

1. Review existing literature to identify what contributes to successful performance on the CE.
2. Provide practical, evidence-based recommendations for preparing surgical trainees for the CE.

Methods

Search strategy

A literature review was conducted. A Pubmed search was performed, including three separate keyword searches for "oral, board, surgery", "ABS, CE", and "certifying examination, surgery". Titles were reviewed for each query and screened for relevance. Duplicate articles were then removed, as were editorials and review articles. Abstracts were subsequently reviewed for relevance and selected. After reading the full manuscripts, references were combed to identify additional articles of relevance. The preferred reporting items for systematic reviews and meta-analysis extension for scoping review (PRISMA-ScR) flow diagram outlining the literature search is shown in Fig. 1.

Results

Data search & manuscript identification

On initial review, 4368 articles were identified. Following an initial screen for relevance and removal of duplicates, 63 unique articles were identified. These references were combed, identifying 5 additional relevant articles. Of these 68 total articles, 18 were removed following review of the abstract for relevance. Five articles were further removed due to being either editorials or reviews. Thus, 45 articles remained for inclusion.

Manuscript review

Manuscripts were then reviewed by theme and grouped into relevant subject matter for further discussion. The first theme dealt with predictors from medical school and is summarized in Table 1. The second theme involved program interventions and is summarized in Table 2. The third theme was candidate factors that are modifiable and is summarized in Table 3. Studies focusing on the value of mock oral exams (MOEs) for CE preparation are summarized in Table 4. Studies that did not show a statistically significant effect of various interventions on ABS CE pass rate are summarized in Table 5.

The CE represents the final step in the board certification process. Identifying factors that influence success on the CE benefits both residency programs and surgery residents. Surgery residency programs are evaluated based on CE pass rate, thus identifying residency candidates more likely to pass the CE as well as identifying existing surgery residents at high risk of failure, to promote remedial actions, clearly benefits both the pupils and the educators. The schema of factors is discussed below.

Candidate factors

General surgery residency programs are evaluated based on their first attempt pass rate for the CE and must meet minimum standards to remain in good standing with the Accreditation Council for Graduate Medical Education (ACGME). Therefore, in choosing residency candidates, a program can benefit from identifying factors that accurately predict passing the CE (see Table 1). However, obtaining predictions of this sort are in general fraught with confounding variables and typically rely on low-quality evidence. A recent systematic review identified known predictive factors and found that most studies were retrospective and level 3 evidence [4]. Despite these limitations, it remains worthwhile to investigate the strength of prediction of various pre-residency candidate factors.

Tests of medical knowledge are common in medical school, culminating in the national United States Medical Licensing Examination
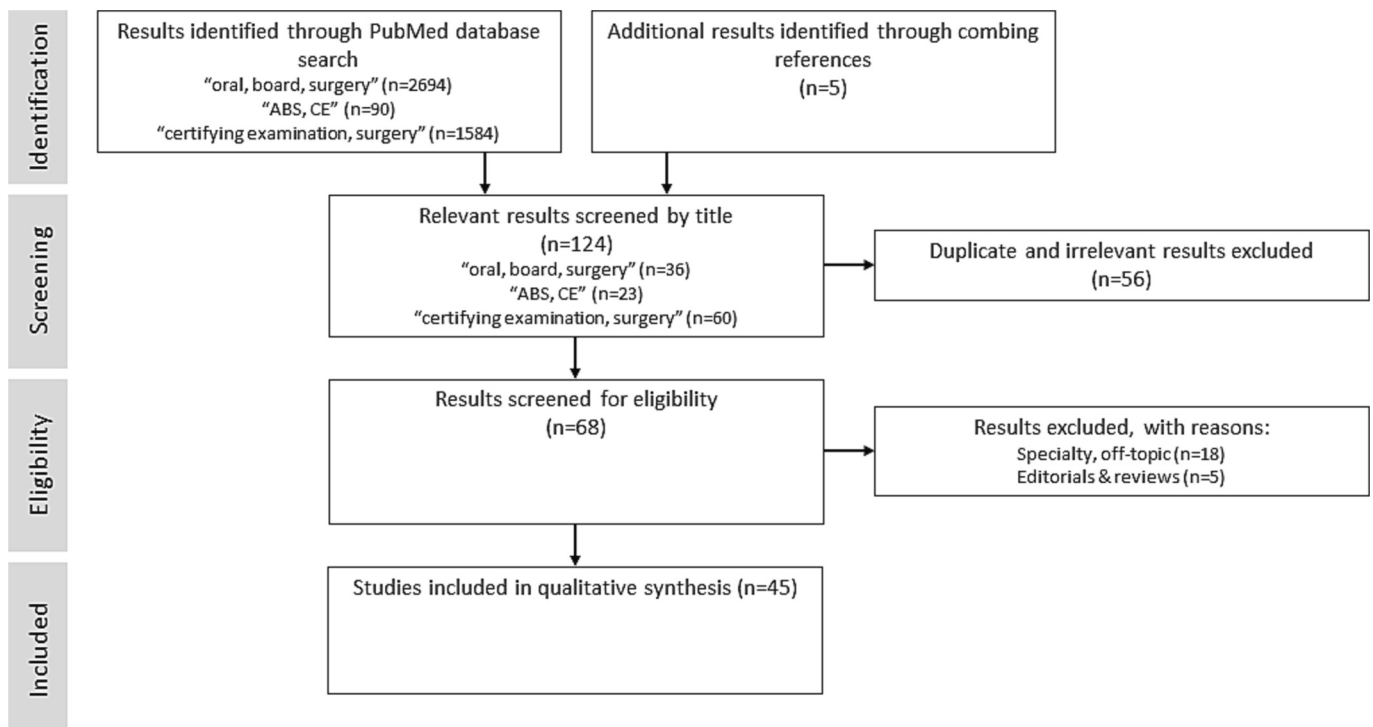

Fig. 1. PRISMA-Scr (Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Review) diagram outlining literature search.

Table 1
Resident selection.

Reference	Study Design	Retro- / Prospective	Years	Institution	# Subjects	Level of Evidence	Notable Findings
USMLE Step 1							
5	Observational Cohort	Retrospective	1990–2001	Single	77	3	Combined ABS QE/CE first-time pass rate was significantly increased in graduates who were in the upper quartile and above the 50th percentile compared to those below on the USMLE Step 1 ($p = 0.0406$ and $p = 0.011$ respectively)
6	Observational Cohort	Retrospective	2000–2007	Multi-Institution	607	3	On multivariable regression, scoring <200 on USMLE Step 1 was associated with failing the ABS CE ($p = 0.02$)
7	Observational Cohort	Retrospective	2001	Multi-Institution	333	3	Residents that passed the ABS CE on first-attempt had significantly higher USMLE Step 1 scores compared to those that did not ($p = 0.005$)
14	Observational Cohort	Prospective	2010–2015	Multi-Institution	242 residency programs	3	A combined ABS QE/CE pass rate was used to identify high-performing (HP) and low-performing (LP) programs. HP programs had a significantly higher average USMLE Step 1 score compared to LP (p < 0.05)
USMLE Step 2							
5	*See Above*						Combined ABS QE/CE first-time pass rate was significantly higher for the top 3 quartiles compared to those below the 25th percentile of the USMLE Step 2 ($p = 0.012$)
7	*See Above*						Residents that passed the ABS CE on first-attempt had significantly higher USMLE Step 2 scores compared to those that did not ($p = 0.006$)
14	*See Above*						A combined ABS QE/CE pass rate was used to identify high-performing (HP) and low-performing (LP) programs. HP programs had a significantly higher average USMLE Step 2 score compared to LP (p < 0.05)
AOA Status							
5	*See Above*						Medical students that were members of AOA had a significantly higher first-pass rate for combined ABS QE/CE ($p = 0.048$)
7	*See Above*						Residents that passed the ABS CE on first attempt were more likely to be a member of AOA ($p = 0.008$)
Medical School Class Rank							
5	*See Above*						Medical students in the top third of their medical school class had significantly higher first-pass rate for combined ABS QE/CE ($p = 0.002$)

Table 1: Summary of manuscripts investigating the characteristics of medical students that can predict performance on the ABS CE. Abbreviations: USMLE, United States Medical Licensing Examination; ABS, American Board of Surgery; QE, Qualifying Exam; CE, Certifying Exam; AOA, Alpha Omega Alpha.

(USMLE) or National Board of Medical Examiners (NBME) Step 1 and Step 2 exams. Multiple studies have found that below average scores on the USMLE or NBME Step 1 exam was associated with failing the CE [5,6], and the averages of both the Step 1 and Step 2 exams significantly differed between candidates that passed the CE on the first attempt and those that did not [7,8]. However, with the recent changes of the Step 1 exam to a pass / fail format, residency programs must rely upon other medical student factors to predict success on the CE.

Obtaining Alpha Omega Alpha (AOA) status appears to predict passing the CE on the first attempt [5,7], as does medical school class rank [5]. While the previously discussed factors may be of use to program directors (PDs) in selecting residency candidates more likely to pass the CE, they are not modifiable by residency programs. Therefore, the ensuing sections will focus on candidate factors of general surgery residents (see Table 2).

Despite differences in format, The American Board of Surgery In-Training Examination (ABSITE) represents a written evaluation encompassing much of the medical and surgical material tested by the CE, and therefore, one would deduce that ABSITE performance would mirror CE performance. In some ways this is true, as scoring below the 35th percentile on the ABSITE examination any year of residency [6] and below the 20th percentile in the post-grad year (PGY) five have been shown to significantly predict failing the CE [8], and average ABSITE scores during years 1, 3, 4, and 5 of residency significantly differed between those that passed and failed the CE on first attempt [5].

However, there is significant noise with the ABSITE, and the ABS did not find it useful for predicting CE pass rates [9].

Performance on the QE represents the final written and objective measure of medical knowledge of a surgical resident prior to the CE. Although a correlation has been found between performance on the QE and CE [3], the strength of this relationship is weak and poorly predictive. Furthermore, identifying risk factors for CE failure should ideally be identified earlier in the educational process than the QE, which is likely taken relatively shortly before attempting the CE.

Some work has analyzed demographics as a variable in board certification [10–12]. However, the reasons behind this variability are unclear. Furthermore, they are not modifiable, cannot ethically be used for predictive purposes, and therefore remain outside of the scope of this review.

Coachable candidate factors

While the prior section focused on candidate factors that may predict passing or failing the CE, the ensuing section identifies modifiable candidate factors to improve CE performance (see Table 3). From 2000 to 2013, 97 % of those who attained board certification passed the CE within two attempts [13]. Furthermore, there seems to be a significant increase in the likelihood of failure with length of time between residency completion and taking the exam [14,15].

As the CE is a significant stressor, problems in communication can

Table 2
Program considerations to maximize ABS CE success.

Reference	Study Design	Retro- / Prospective	Years	Institution	# Subjects	Level of Evidence	Notable Findings
Structural Considerations							
Experience at Level 1 Trauma Center							
14	Observational Cohort	Prospective	2010–2015	Multi-Institution	242 residency programs	3	A combined ABS QE/CE pass rate was used to identify high-performing (HP) and low-performing (LP) programs. HP programs were more likely to rotate at a level 1 trauma center ($p < 0.05$)
Mature Fellowship Program							
14	*See Above*						A combined ABS QE/CE pass rate was used to identify high-performing (HP) and low-performing (LP) programs. HP programs had more fellowship programs compared to LP programs (p < 0.05)
Larger Program Size							
21	Observational Cohort	Retrospective	2006–2011	Multi-Institution	237 residency programs	3	A linear regression between program size and ABS CE pass rate showed significant correlation ($p < 0.001$)
Research Year							
6	Observational Cohort	Retrospective	2000–2007	Multi-Institution	607	3	On multivariable regression, a mandatory research year was associated with an increased likelihood of passing the ABS CE (p < 0.001)
More Operative Time							
22	Cross-sectional Survey	n/a	2014–2019	Multi-Institution	6269	4	Programs with more satisfaction with operative time (as determined by resident survey) were found to have a higher ABS CE pass rate ($p = 0.009$)
Functional Considerations							
ABSITE Scores							
5	Observational Cohort	Retrospective	1990–2001	Single	77	3	PGY-1 & PGY-3 ABSITE scores above 50th percentile had significantly higher combined ABS QE/CE first-pass rate compared to those below 50th percentile (p = 0.011 and p = 0.001 respectively) PGY-4 & PGY-5 ABSITE scores above the 33rd percentile had significantly higher combined ABS QE/CE first-pass rate compared to those who scored below the 33rd percentile ($p = 0.001$ and $p = 0.003$ respectively)
6	*See Above*						On multivariable regression, scoring below the 35th percentile on the ABSITE at any point during residency predicted failing the ABS CE (p < 0.001)
8	Observational Cohort	Retrospective	2010–2019	Single	26	3	PGY-5 ABSITE scores above the 30th percentile had higher CE pass rate compared to those that did not (p = 0.002)
ABS QE Performance							
3	Observational Cohort	Retrospective	2006–2010	Multi-Institution	4385	3	Correlation coefficient between passing CE and QE on first attempt was small, but statistically significant ($\phi = 0.13$, p < 0.001) ROC analysis indicates relation between passing CE and QE, but does not meet typical standards of significance (AUC = 0.674; $p < 0.001$)
21	*See Above*						Residency program QE pass rate was found to correlate with CE pass rate ($r = 0.43$)
SCORE Use							
28	Observational Cohort	Retrospective	2015–2019	Single	33	3	Compared combined first-pass rate for ABS QE/CE prior to (2013–2015) and after (2016–2019) implementing the SCORE curriculum and found an increase from 70.8 % to 93.9 % ($p = 0.018$)
Weekly Assigned Readings							
29	Observational Cohort	Prospective	1997–2007	Single	49	3	Regression analysis shows that for each year of exposure to assigned weekly reading program, the OR for passing both the ABS QE and CE increased by 2.2 (p = 0.04)
Low PD Turnover							
30	Observational Cohort	Retrospective	2013–2017	Multi-Institution	255 GS programs	3	Programs with low PD-turnover (< 4 PD changes over 18-year period) have a higher mean ABS CE first-pass rate (p < 0.01) compared to high PD-turnover (≥ 4 PD changes over 18-year period)

Table 2: Summary of manuscripts that investigate structural and functional characteristics of general surgery residency programs that can predict performance on the ABS CE. Abbreviations: ABS, American Board of Surgery; QE, Qualifying Exam; CE, Certifying Exam; MOE, Mock Oral Exam; MSCE, Monthly Simulated and Critiqued Oral Examinations; PGY, Postgraduate Year; ABSITE, American Board of Surgery In-Training Examination; ROC, Receiver Operating Characteristic; SCORE, The Surgical Council on Resident Education curriculum; PD, Program Director.

Table 3
Coachable candidate factors.

Reference	Study Design	Retro- / Prospective	Years	Institution	# Subjects	Level of Evidence	Notable Findings
Take the Exam as Soon as Possible							
14	Observational Cohort	Prospective	2010–2015	Multi-Institution	242 residency programs	3	A combined ABS QE/CE pass rate was used to identify high-performing (HP) and low-performing (LP) programs. Residents of HP programs were more likely to take ABS exams within one year of graduation (p < 0.05)
15	Observational Cohort	Retrospective	2006–2010	Multi-Institution	5193	3	Those that delay taking the ABS QE (> 1-year) have a lower CE first-pass rate than those that take the exam within one year from graduation ($p < 0.001$) Those that delay taking the ABS QE required a greater number of mean attempts to pass the ABS CE
Communication Skills							
16	Observational Cohort	Prospective	1991–2001	Multi-Institution	122	3	Residents enrolled in an oral examination course focusing on communication deficits. Those with available follow-up data and that completed the course were found to have a CE pass rate of 96 % (compared with national average of 77 % - 80 % over that time)
17	Cross-sectional Survey	n/a	2015	Multi-Institution	103	3	78 % of PDs surveyed agree or strongly agree that strong communication skills are an attribute of residents that pass the ABS CE
20	Observational Cohort	Prospective	1991–2011	Multi-Institution	326	3	Residents enrolled in an oral examination course that focused on communication deficits. Of those available for follow-up (69.0 %), 97 % who completed the course and individualized remediation plan passed the ABS CE.
Confidence							
17	*See Above*						88 % of surgical PDs surveyed agree or strongly agree that confidence is an attribute of residents that pass the ABS CE
Professionalism							
19	Cross-sectional Survey	n/a	1995	n/a	n/a	3	Mock examinees' verbal style of presentation, dress, and answer content influenced examiners' ratings
20	Observational Cohort	Prospective	1991–2011	Multi-Institution	326	3	Residents enrolled in an oral examination course that focused on professionalism deficits. Of those available for follow-up (69.0 %), 97 % who completed the course and individualized remediation plan passed the ABS CE.

Table 3: Summary of manuscripts investigating modifiable candidate characteristics and their effects on ABS CE performance. Abbreviations: ABS, American Board of Surgery; QE, Qualifying Exam; CE, Certifying Exam; PD, Program Director.

develop even among qualified candidates leading to poor outcomes [16]. According to surveys, PDs identified confidence and good communication skills as personal attributes likely to predict success on the CE [17]. The ABS itself has written that candidates need to be concise and engaging in the virtual environment [18]. Furthermore, it has been shown that an examinee's dress and verbal style can influence favorability in the context of an oral examination [19]. Fortunately, courses designed to address deficiencies in professionalism and communication skills have been shown to be beneficial to those undertaking the CE [20].

Program factors

While the CE tests medical knowledge similar to the QE, its unique oral format further requires a unique skillset to ensure success. Therefore, it is not unexpected that there are multiple factors intrinsic to surgical programs that can affect a candidate's probability of success. These program factors are further broken down into structural and functional factors.

Program factors: structural

While required to maintain certain minimal requirements by the ACGME, their remains some freedom in the structural components of a general surgery residency. Therefore, it is prudent to investigate how these variations can influence the probability of success on the CE (see Table 2). It was found that rotating at a Level I trauma center during residency was associated with greater success on the CE [14]. Furthermore, the presence of multiple fellowship programs was also found to be correlated with passing the CE [14]. There was found to be a statistically significant, positive correlation between first-time pass rate on the CE and program size, lending support to the authors' hypothesis that a larger surgical residency program could be associated with a more robust resident education program [21]. The presence of a mandatory research year also predicted success on the CE in a multivariate model [6]. In self-reported survey results, residents reporting satisfactory operative time during training were more likely to pass the CE on first attempt [22], although multiple subsequent studies have failed to find a connection between operative cases completed and success on the CE [14,23].

There remain some non-modifiable structural characteristics of

Table 4

Value of mock oral exams.

Reference	Study Design	Retro- / Prospective	Years	Institution	# Subjects	Level of Evidence	Notable Findings
MOEs: Public							
38	Observational Cohort	Prospective	2006–2009	Single	62	3	Following institution of public MOEs, CE first-pass rate increased from 88 % to 100 %, although this was not found to be statistically significant ($p = 0.3$) Both the examinees and the audience reported a high level of satisfaction with the MOE format
MOEs: Monthly							
31	Observational Cohort	Prospective	2007–2015	Single	46	3	First-pass rate of the ABS CE increased from 76.0 % to 100 % after institution of a monthly CE MOE preparatory course ($p = 0.025$) Resident performance on the MOE was associated with passing the CE ($p = 0.001$)
32	Observational Cohort	Prospective with historical controls	2001–2006	Single	36	3	MSCE implementation increased CE pass rate ($p = 0.038$) MSCE ranked as third most helpful preparation method (behind clinical experience, independent reading)
MOEs: Multi-Institutional							
33	Observational Cohort	Prospective	2011–2014	Multi-Institution	124	3	Participation in the MOE program PGY-4 year and sequentially was associated with first-time passing of the ABS CE ($p = 0.045$ and p = 0.03, respectively) Participation in multiple MOEs remained associated with passing the ABS CE in a multivariable logistic regression (OR = 1.4; 95 % CI: 1.1–2.7)
Practice Critical Thinking							
32	Observational Cohort	Prospective with historical controls	2001–2006	Single	36	3	On survey of participants, the reported benefit of MSCE is forced exercise of clinical reasoning ($p < 0.01$)
37	Observational Cohort	Prospective	2002–2012	Single	63	3	4th year & 5th year MOE scores did not predict ABS CE first pass rate ($p = 0.238$ and $p = 0.240$, respectively) 77.1 % of former residents reported MOE as very or extremely helpful for CE preparation
39	Observational Cohort	Retrospective	2001–2010	Single	30	3	Residents that passed the ABS CE on first attempt received higher in-house and city-wide MOE professional communication scores (p = 0.01 and p = 0.02, respectively)
44	Observational Cohort	Prospective with historical controls	2003–2012	Single	56	3	Participation in ACES program, focusing on 'examanship' and presentation skills, increased ABS CE first-pass rate compared to historic controls ($p = 0.049$).
46	Observational Cohort	Retrospective	2009–2013	Multi-Institution	189	3	Of residents that participated in a multi-institution MOE, those that failed the MOE received more total feedback in cognitive knowledge than those that passed (p = 0.04)
47	Observational Cohort	Prospective	2019–2021	Single	10	3	Self-reported, peer, and examiner medical knowledge, confidence, and anxiety scores correlated with overall score ($R^2 = 0.7326$, $R^2 = 0.4681$, and $R^2 = 0.2466$, respectively) Confidence scores improved with subsequent practice (p < 0.05)
Identify Those At-Risk							
33	*See Above*						Better 'best performance' on the MOE predicted first-time passing of the ABS CE (p = 0.01) Residents classified as 'at-risk' following an MOE performance who improved to 'intermediate' or 'likely to pass' on subsequent testing had a significantly higher ABS CE first-pass rate (p = 0.03)
39	*See Above*						In-house MOE score significantly differed among those that passed and failed the ABS CE on first attempt (p = 0.03)
40	Observational Cohort	Retrospective	2003–2010	Multi-Institution	38	3	A regional MOE was found to have 81.6 % accuracy in predicting the outcome of the ABS CE, although the sensitivity was 83.8 %, specificity 0 %, positive predictive value 96.9 %, and negative predictive value 0 %.
Identify Program Weaknesses							
41	Observational	n/a	n/a	Single	n/a	5	Commentary noting that the institution of MOEs may help to identify deficiencies in resident exposure and education
42	Cross-sectional Survey	n/a	2019	Multi-Institution	33	4	Higher medical knowledge ratings (not patient care or interpersonal communication skills) were associated with MOE performance Propose that noted MOE deficiencies could inform program-level changes
43	Observational Cohort	Prospective	2008–2014	Multi-Institution	259	3	Each of the three institutions included in a city-wide MOE were found to be significantly deficient in a unique surgical

Table 4 (*continued*)

Reference	Study Design	Retro- / Pro-spective	Years	Institution	# Subjects	Level of Evidence	Notable Findings
							subspeciality; this could prompt evaluation of resident education and exposure to these surgical areas.

Table 4: Summary of manuscripts investigating the value of mock oral exams for ABS CE preparation. Abbreviations: MOE, Mock Oral Exam; MSCE, Monthly Simulated and Critiqued Oral Examinations; ABS, American Board of Surgery; CE, Certifying Exam; ACES, Advanced Certifying Examinations Simulation.

surgical programs that can predict success on the CE. For example, there seem to be regional variations [10,24–26], as well as superior performance by university-based over community programs [26,27]. In addition, military programs seem to have a higher pass rate than civilian programs [27]. While we note these are interesting findings, they are not realistically actionable at a program level.

Program factors: functional

Outside of the surgical structure of surgery residencies, there exist multiple factors that could influence success on the CE, henceforth referred to as functional program factors. A list of these factors that were found to improve CE outcomes are listed and Table 2 and are summarized below.

The Surgical Council on Resident Education (SCORE) Curriculum was developed as an easily accessible, online resource designed to meet educational goals for the ABSITE and QE. A retrospective study of a single institution found a significant improvement in CE pass rate following implementation of the SCORE curriculum for surgical residents [28]. Furthermore, exposure to a weekly assigned reading program increased the combined pass rate for the QE and CE [29]. A general surgery residency PD is a significant position of influence and leadership within a residency program and are thus expected to maintain their position for at least 6 years. A multi-institutional, retrospective study has found that residency programs with high PD turnover performed significantly worse on the CE compared to low turnover programs [30].

Mock oral examinations

Due to the CE's unique format, mock oral exams (MOEs) have been commonly implemented in many surgical residencies with the goal of helping to prepare their residents for the CE. An MOE can provide benefit in multiple ways: they can provide an opportunity to practice and improve skills to increase likelihood of passing the CE, identify examinees' deficiencies that can be actionably improved, as well as provide an early warning of possible CE failure. Some of the potential benefits of MOEs are summarized in Table 4. The following section aims to summarize these potential benefits.

In two separate single-institution studies, the implementation of a structured, monthly, single-institution, MOE program significantly improved first-pass rate on the CE [31,32]. A similar benefit was found with an annual, multi-institution MOE program [33]. A systematic review in 2015 found that mock oral examinations seem to modestly improve performance on the CE, although the authors note that both the quality and quantity of evidence in these investigations are lacking [34]. Despite this deficit, the use of a public mock oral has been shown to be valued by PDs [35], those residents participating in the MOE [36,37], as well as the residents in the audience observing the exams [38].

Both single-institution [39] and multi-institution [33,40] retrospective studies, have found that poor performance on MOEs can predict failure on the CE. It has also been shown that a strong score on MOEs can predict success on the CE [31]. However, it is also important to note that some studies have not found a correlation between MOE scores and likelihood of passing the CE [37]. A multitude of factors can explain these discrepancies: from differences in study design, underpowered studies, and differences in how or when particular MOE programs have been implemented.

A formal MOE program can also provide benefit to surgery residencies by revealing deficiencies in resident education that can be better identified in a comprehensive, open-ended oral format [41]. Such benefit was found by surveying faculty examiners participating in an MOE series [42]. Furthermore, in a prospective, multi-institutional study, an MOE program showed that while all institutions performed above the national average in gastrointestinal and general surgery, each program was found to have statistically significant failure rates in particular sub-specialties, which could in turn prompt programs to address specific deficiencies in resident exposure or education [43].

Despite the wide adoption of mock-oral programs, there exist questions as to the specific manner in which they should be used. The implementation of a specialized preparatory program that incorporates communication skills, anxiety management, maintenance of a confident demeanor, among other skills globally referred to as 'examanship' was found to significantly improve CE first-pass rate compared to a standard monthly mock-oral program in a single center study [44]. In a study published in 2018, a survey of PDs showed that half of programs reported holding MOEs two or three times a year, with another third performing them annually [35]. This same survey revealed that PGY-4 and PGY-5 levels are routinely included, with the PGY-3 level included 53 % and more junior levels about 20 % of the time [35]. There is also variability in the number of examiners, the associations of the examiners, frequency of exams, as well as where the testing takes place. Intuition would imply that allowing more frequent MOEs would benefit the examinees, however, adequate faculty participation and the development of original questions represent barriers to frequent MOEs [35]. In addition, the quality of the examination may be decreased by inexperienced faculty examiners [19]. Notably, with the shift towards virtual oral examinations due to the COVID pandemic, the virtual format does not seem to have changed CE pass rates, and it seems likely to remain [18]. It also seems to have been favorably received by resident participants. However, although programs that have incorporated virtual MOE options have found them to be generally successful and well-received, they were less preferred by both resident and faculty participants than in-person experiences [45].

While it seems intuitive that practicing questions in the style of the examination would lead to success, interestingly, some studies have found that pass rates on mock exams do not seem to correlate well with ABS CE pass rates, lending credence to the belief that the elements of practice and feedback are more important than the content [37,46]. This is supported by another single-institution observational study that noted a significant improvement in the level of anxiety felt by examinees with successive practice [47].

Factors showing no correlation with ABS CE success

While much effort has been made to identify factors that can benefit those preparing the CE, it is perhaps equally as useful to identify those factors that do not seem to show significant benefit (see Table 5). Perhaps surprisingly, commercial review courses do not seem to increase pass rates. Although the majority of candidates take a course, no correlation was found in a thoughtful review from the ABS itself [48]. This finding has been corroborated in a survey of 410 individuals [49]. Furthermore, the use of the Surgical Education and Self Assessment Program (SESAP) was not associated with better performance on the CE [50].

Table 5
Studies Showing No Correlation with ABS CE Success.

Reference	Study Design	Retro- / Pro-spective	Years	Institution	# Subjects	Level of Evidence	Notable Findings
ABSITE							
9	Observational Cohort	Retrospective	2006–2012	Multi-Institution	1329	3	1st and 5th year ABSITE scores statistically predict ABS CE outcome ($p < 0.001$). However, the model predicts that all would pass; thus is not a practical predictor of outcomes
Duty Hours							
52	Observational Cohort	Retrospective	1998–2005	Single	Not reported	3	ABS CE pass rate was compared prior to and after institution of an 80-h work week and was not found to be significantly different
53	Observational Cohort	Retrospective	2015–2016	Multi-Institution	533	3	Noted no difference in ABS CE pass rate between residents in the Flexible Policy vs Standard Policy schedule in the FIRST Trial ($p = 0.24$)
English as First Language							
38	Observational Cohort	Retrospective	2001–2010	Single	30	3	The rate of English as first language did not differ between those that passed ABS CE on first attempt and those that failed ($p = 0.71$) The rate of international medical school graduates did not differ significantly between those that passed ABS CE on first attempt and those that failed ($p = 0.26$)
Gender							
7	Observational Cohort	Retrospective	2001	Multi-Institution	333	3	ABS CE first-pass rate did not differ depending on examinee gender ($p = 0.792$)
38	See Above						Gender did not differ significantly among those that passed ABS CE on first-attempt or those that failed ($p = 1.00$)
54	Observational Cohort	Retrospective	2016–2017	Multi-Institution	1341	3	ABS CE first-pass rate did not differ depending on examinee gender, examiner gender, or all gender combinations of examinee and examiner (all p-values >0.05)
Operative Dictations							
23	Observational Cohort	Retrospective	2009–2013	Single	24	3	Number of operative dictations, proportion of dictations, and dictations classified by anatomic location did not differ between those that passed or failed the ABS CE on first attempt
Operative Case Volume							
6	Observational Cohort	Retrospective	2000–2007	Multi-Institution	607	3	No significant difference was noted in the average case volume for those that passed or failed the ABS CE ($p = 0.40$)
23	See Above						Number of operative cases did not differ between those that passed or failed the ABS CE on first attempt
Remedial Year							
51	Observational Cohort	Retrospective	1986–2002	Multi-Institution	88	3	ABS CE pass-rate did not improve following the addition of a remedial year (72 % vs 73 %)
SESAP, Selected Readings							
50	Observational Cohort	Retrospective	1976–1993	Single	56	3	The use of SESAP or selected readings was not associated with success on the ABS CE
Subspecialty Fellowship vs. General Surgery Practice							
49	Observational Cohort	Retrospective	1997–1998	Multi-Institution	465	3	There was no observed difference in CE first-pass rate in those in private practice or academic general surgery; thoracic, vascular, or practice surgery fellowships, or other surgical fellowships
Review Courses							
48	Observational Cohort	Prospective	2012–2013	Multi-Institution	1386	3	ABS CE pass rate did not differ for first-time or repeat examiners who did or did not take a commercially available review course ($p = 0.32$ and $p = 0.24$, respectively)
49	See Above						No observed difference in CE first-pass rate in those that utilized a commercial preparatory course
50	See Above						The use of a review course was not associated with success on the ABS CE

Table 5: Summary of manuscripts that identified factors that did not affect performance on the ABS CE. Abbreviations: ABSITE, American Board of Surgery In-Training Exam; ABS, American Board of Surgery; CE, Certifying Exam; FIRST Trial, Flexibility in Duty Hour Requirements for Surgical Trainees Trial; SESAP, Surgical Education and Self-Assessment Program.

Due to the unique format of the CE, it has traditionally been thought that completing operative dictations would prepare residents. However, a single-institution retrospective study did not find such a connection [14]. On a lesser level, an "appropriate" time in the operating room correlated with passing the CE, as it may represent practice at articulating decision-making [22].

If a resident is unable to pass the QE and/or CE within their allotted attempts, the ABS permits such residents to undergo a remediation year to help regain eligibility to retake the necessary exams. Although this year of remediation has been shown to improve the pass rate on the QE, unfortunately, it has not shown any benefit in increasing the pass rate for the CE [51]. Furthermore, the choice of subspecialty fellowship versus a general surgery fellowship does not appear to effect success on the CE [49].

Following initiation of the 80-h work week limit to general surgery residency, there was concern that resident education would be negatively affected. However, in a 7-year prospective, observational study, it found that first-pass rate was unchanged following implementation of the new duty hour limitation [52]. The implementation of the Flexibility in Duty Hour Requirements for Surgical Training Trial (FIRST) relaxed several criteria required in the traditional ACGME-implemented duty hour requirements with the goal of increasing continuity of care, resident education, as well as resident well-being. A prospective trial comparing CE first-pass rate in residents under the traditional duty hour and FIRST structures did not find a statistically significant difference [53].

There are also multiple, non-modifiable factors that do not influence performance on the CE. It has been shown that whether English is one's native or non-native language does not affect first pass rate on the CE [39]. Furthermore, there is not an effect of either the examinee's gender or all combinations of examinee and examiner gender combinations [54].

Discussion

As shown, many factors on both a program and individual level can predict or improve one's performance on the CE. In terms of predicting one's performance, when looking at medical students applying to surgical residency, one can utilize USMLE Step 1 or Step 2 scores, as well as AOA status, and class rank. Notably, the USMLE Step 1 is now pass / fail and thus provides less predictive value in this context. Furthermore, many of these variables are already highly valued by surgical PDs when ranking resident applicants and thus aren't unique or unexpected findings [55].

Continuing with the theme of predicting success or failure on the CE, our review discusses multiple studies that one's ABSITE performance through residency is correlated with success on the CE. Specifically, it seems that poor performance on the ABSITE predicts an increased risk of failing the CE, with weaker evidence suggesting that strong performance predicts success. These studies are observational, and thus while it might be tempting to think that improving one's ABSITE score will increase odds of success on the CE, it is probably more accurate to think of poor ABSITE performance as an early red flag. Similar conclusions can be drawn concerning the QE, except that one typically takes the QE near to the CE thus not permitting significant remedial action.

Next there seem to be certain specific actions a candidate can undertake to increase their odds of passing the CE. For example, one should take the exam as soon as possible. Such evidence has prompted the advice from Chris Ellison: "take it early or take it often" [15]. Furthermore, one should both dress and speak professionally. Furthermore, evidence shows that certain CE preparatory courses that focus on 'examanship' as proposed by London et al. seem to benefit candidates, even beyond structured MOEs [44]. While such a course would require a time and financial commitment from candidates, it could provide a significant benefit to those identified to be at risk of CE failure.

Although adjusting the structure of a residency program can

certainly be difficult, it remains interesting to investigate which structural program factors may influence performance on the CE. The structural program factors that predict success (e.g. rotation at a level 1 trauma center, presence of mature fellowship programs, mandatory research years) are likely correlated with larger programs, which, as discussed, may have more robust education programs [21] or may be due to exposure of more complex surgical patients. Again, due to the observational nature of studies investigating these factors, identifying the specific contributory factors is difficult. However, simpler residency changes, such as implementation of the SCORE curriculum or assigned weekly readings, appear to provide benefit and are relatively straightforward to implement.

Although there exists some variability in the data, implementation of structured MOEs seems to both increase one's chances of passing the CE and identify those students at risk of failure. These benefits seem to remain despite differences in implementation (e.g. monthly vs. annually; single- vs. multi-institution) and may provide benefit to both senior and junior residents.

While a stated goal of this review was to identify characteristics that would predict or increase one's chances of passing the CE, it is perhaps equally valuable to identify those that do not. Specifically, it seems that commercial review courses and SESAP participation do not affect one's CE performance. Interestingly, participation in a remediation year also does not seem to increase one's chances of passing the CE. Perhaps, with a better understanding of which specific factors can influence one's performance on the CE, one can design a remediation year with specific experiences focusing on improving CE performance.

Despite the seemingly numerous studies examining what factors influence performance on the CE, research into these factors is of low quality. The investigations are typically observational, and many are retrospective in design. Despite this setback, multiple factors can be used to identify residents at risk of failing the CE and specific interventions can be applied to improve their performance on the CE.

Ethics statement

Not applicable.

CRediT authorship contribution statement

Matthew D. Cahn: Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Ace St. John:** Data curation, Investigation, Methodology, Writing – review & editing. **Stephen M. Kavic:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors of this manuscript have no related conflicts of interest to declare.

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