Research Paper

# Reimagining general surgery resident selection: Collaborative innovation through design thinking

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## ARTICLE INFO

## ABSTRACT

*Introduction:* The process by which surgery residency programs select applicants is complex, opaque, and susceptible to bias. Despite attempts by program directors and educational researchers to address these issues, residents have limited ability to affect change within the process at present. Here, we present the results of a design thinking brainstorm to improve resident selection and propose this technique as a framework for surgical residents to creatively solve problems and generate actionable changes.

*Methods:* Members of the Collaboration of Surgical Education Fellows (CoSEF) used the design thinking framework to brainstorm ways to improve the resident selection process. Members participated in one virtual focus group focused on identifying pain points and developing divergent solutions to those pain points. Pain points and solutions were subsequently organized into themes. Finally, members participated in a second virtual focus group to design prototypes to test the proposed solutions.

*Results:* Sixteen CoSEF members participated in one or both focus groups. Participants identified twelve pain points and 57 potential solutions. Pain points and solutions were grouped into the three themes of transparency, fairness, and applicant experience. Members subsequently developed five prototype ideas that could be rapidly developed and tested to improve resident selection.

*Conclusions:* The design thinking framework can help surgical residents come up with creative ideas to improve pain points within surgical training. Furthermore, this framework can supplement existing quantitative and qualitative methods within surgical education research. Future work will be needed to implement the prototypes devised during our sessions and turn them into complete interventions.

*Key message:* In this paper, we demonstrate the results of a resident-led design thinking brainstorm on improving resident selection in which our team identified twelve pain points in resident selection, ideated 57 solutions, and

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developed five prototypes for further testing. In addition to sharing our results, we believe design thinking can be a useful framework for creative problem solving within surgical education.

## Introduction

The surgical residency selection process is challenging for both applicants and program directors, especially at a time when more students are applying to more programs [1]. Given its scope and complexity, the application process is resistant to large-scale changes. Currently, applications contain quantitative data (test scores, transcripts), structured qualitative data (medical student performance letter, situational judgment tests), and unstructured qualitative data (personal statement, letters of recommendation) [2]. Applications are often pre-screened; while some programs use score cutoffs on United States Medical Licensing Exams (USMLE), others opt for holistic review. The goal of both approaches is to winnow the applicant pool to a number that is practical to interview [3,4]. Interviews are conducted without consistency in structure or format across institutions. As a result, applicants must prepare for a variety of interview styles and practices, including structured or unstructured one-on-one conversations, panel interviews, or skills assessments [5,6]. Finally, programs hold a meeting to build their rank lists. However, the nature of these discussions and persons involved also vary by institution. This lack of transparency leads to concerns over an equitable selection process [7]. Moreover, recent changes such as the transition to virtual interviews, implementation of second looks, and inclusion of signaling add further complexity and heterogeneity [8–10].

Recently, an Association of Program Directors in Surgery (APDS) taskforce published guidelines for the 2023–2024 recruitment cycle to improve the transparency and standardization of the application process [11]. Due to inconsistent adherence to these recommendations, the process continues to be non-standardized, opaque, and susceptible to bias [12,13]. We, the Collaboration of Surgical Education Fellows (CoSEF), are a group of surgical residents with experience in surgical education research [14]. Additionally, many of us are involved in aspects of applicant selection at our institutions. Given this unique position, CoSEF members have insight into the challenges of residency selection from both the perspective of applicants and education leadership. Finally, given our investment in surgical education, some of us may one day be able to oversee changes to the resident selection process. Thus, our group is uniquely qualified to suggest possible reforms.

In this paper, we aim to provide a trainee-centric perspective on how to improve resident selection. To refine our ideas, we held two brainstorming sessions utilizing design thinking: a problem-solving framework that focuses on identifying pain points in a current process or workflow, generating as many ideas as possible to solve these pain points, and developing practical prototypes to test each idea for feasibility and traction [15]. In doing this exercise, we felt it would be useful to share both our product and our process. The objectives of this paper are thus two-fold: first, to jumpstart a conversation on reimagining surgical resident selection and second, to demonstrate the utility of design thinking as a useful brainstorming framework within surgical education.

## Methods

### Design thinking framework

While there are many ways to perform design thinking, we followed a three step process involving: (1) pain point identification, (2) divergent ideation, and (3) prototype development (Fig. 1) [15].

In the first step, we identify pain points, which are human frustrations that help identify gaps in which innovation is necessary. In the second step, we focus on divergent ideation, in which participants attempt to generate as many solutions to a problem as possible without considering how "good" or "practical" an idea may seem. The rationale behind this technique is that exploring ideas that seem unlikely to work can augment creative thinking and open mental pathways to previously unexplored solutions. In the third step, we create prototypes. Our definition of a "prototype" is broader than the concept of a miniature or simplified object or process that the word commonly evokes. Any solution contains within it certain inherent assumptions about why it will work and, in our case, why people will adopt it. In design thinking, a prototype is any representation of a solution that can meaningfully test any of these assumptions. For example, imagine we wanted to solve the pain point of *interviewer bias* and our solution idea was a novel online curriculum. In this example, we would be making several assumptions such as: (1) interviewers know they are biased, (2) interviewers are



# Design thinking is a problem-solving framework that can help drive innovation in surgery

Surgical education research is one area in which this framework can be applied right away

**Understand a problem through the frustrations or pain points of the people affected**

HOW MIGHT WE...?   IT FRUSTRATES ME WHEN...

**Come up with as many solutions as possible**

OK   TO   THINK   THE   OUTSIDE   BOX

**Develop and iteratively improve prototypes through experimentation**

**Fig. 1.** Schematic of the design thinking process.

interested in reducing their bias, (3) interviewers have time for an online curriculum, and (4) interviewers will take our online curriculum without external incentives. Rather than developing the whole curriculum only to find that no one is using it, we could post a proposed syllabus on social media and measure engagement. Positive engagement would support that potential interviewers believe our problem is real and want to solve it. On the other hand, a lack of engagement would compel us to pivot and try another idea. Iterative development then follows by using increasingly complex prototypes to test complex hypotheses.

Design thinking requires a psychologically safe environment to be successful. We emphasized the safety of our environment by establishing the following ground rules for our sessions: 1) Any idea is a valid idea, regardless of feasibility or practicality; 2) Participants should support, and not critique, any individual members' contributions; 3) Focus should be on quantity over quality; and 4) When sharing in a group, every participant must share at least one idea. Of note, emphasizing quantity over quality is a well-established feature of design thinking. Generating many ideas is thought to protect against prematurely choosing seemingly feasible solutions at the cost of potentially better ones. Moreover, since all ideas require significant iteration, ideas that seem impractical at first may unexpectedly lead to novel, creative solutions [16]. We abstracted these ground rules from a variety of sources to capture the core ideas of the design thinking framework [17,18].

*Brainstorming logistics*

We conducted two virtual, one-hour brainstorming sessions. The first session focused on identifying pain points in the resident selection process as well as potential solutions. Three CoSEF members (TS, JL, RM) served as session moderators and met before the session to review logistics. The second session focused on developing prototypes from the solution pool. One member (TS) served as a session moderator. While we did not explain the principles of design thinking to participants in detail, all session moderators were familiar with the framework and all participants received just-in-time instructions. Moderators introduced ground rules for psychological safety - as defined above - at the beginning of each session.

*Identification of pain points and solutions*

For the initial session, we focused on (1) pain point generation and (2) divergent ideation. For each component, we asked participants to complete time-bound individual and group brainstorming activities. The purpose of individual brainstorming was to generate multiple ideas independently for discussion in the group phase. Each participant was asked to share one of their individual ideas to avoid groupthink and to ensure that less vocal members of the group had an opportunity to contribute.

For pain point generation, we asked participants to identify current frustrations with the residency recruitment process. To assist with brainstorming, session moderators developed six pain points ahead of the session and shared these ideas with participants. We gave participants two minutes to brainstorm pain points individually. Then, we spent ten minutes in a large group allowing each participant to share at least one additional pain point they identified.

Next, we asked participants to brainstorm potential solutions to the pain points previously identified. For this portion, we split participants into three equal small groups, each facilitated by a session moderator. Moderators suggested that each group identify one pain point or a series of related pain points around which to center their ideation, but we did not enforce this rigidly. For this portion, we gave participants five minutes to individually come up with solutions, then asked each participant to share at least one solution. After sharing, we encouraged a free-flowing group discussion. Finally, all participants met as a large group to share their small group discussions; one member from each group

provided a summary of the solutions discussed.

*Analysis of themes*

One organizer (TS) de-identified and thematically categorized all brainstormed pain points and solutions. To ensure validity, these themes were subjected to member checking in a subsequent CoSEF meeting. The process concluded with no major disagreements.

*Prototype development*

To develop prototypes for improving the resident selection process, we held a second one-hour meeting. As in the first session, the moderator provided just-in-time knowledge about prototype development as well as examples (such as the above example on interviewer bias). In this meeting, we allowed for free discussion of prototype ideas. Recognizing that large-scale changes to the interview process require administrative buy-in, research validation, and regulatory approval, we aimed to develop prototypes that could be deployed immediately to maximize the potential immediate impact on applicants. The prototypes presented were agreed upon through consensus of the members present in the second meeting and then shared with the larger group. There were no major disagreements.

**Results**

*Demographics*

Sixteen CoSEF members participated in one or both of the brainstorming sessions. Fourteen attended the first session and ten attended the second session. Eight members attended both sessions. These members represented twelve academic surgical institutions across ten states in the United States. Twelve of sixteen (75 %) were research residents, two (13 %) were PGY4 residents, one (6 %) was a PGY1 resident and one (6 %) was a fellow. Eight (50 %) participants identified as female while eight (50 %) identified as male. Twelve (75 %) were White or European, three (19 %) were Asian or Asian American, and one (6 %) was Hispanic or Latino.

*Pain point identification*

During the ten minutes of pain point generation, participants generated twelve pain points in addition to the six pain points previously identified by session moderators and shared with participants. A complete list of pain points is included in Table 1.

*Solutions*

Participants generated 57 initial solutions in response to the pain points described. As solution generation was performed in small groups, some ideas were repeated between groups (e.g., S5, S15, and S23 all refer to bias training for interviewers). Sometimes, one idea led to a secondary idea (e.g., S37, S38, S39, which started with increasing transparency around the number of interviews offered and led to making the selection algorithm and even the rank list transparent). A complete list of solution ideas is included in Table 2.

*Analysis of pain points*

Following the pain point and solution brainstorming session, one event organizer (TS) identified three broader themes: fairness, transparency, and applicant experience. The first theme of **fairness** captured all pain points pertaining to the fairness of the application process as related to race, geography, medical school status, financial status, or network. The second theme of **transparency** captured all pain points related to lack of applicant knowledge about the process as well as areas

**Table 1**

Pain Point Generation. Grammatical editing of pain points was performed to ensure readability with an emphasis on capturing the spirit of what was said by participants. Bolded pain points were determined ahead of time by session organizers and proposed at the beginning of the session to spark discussion.

| Identifier | Pain point | Theme |
|---|---|---|
| P1.1 | How might we reduce the financial burden on prospective applicants? | Fairness |
| P1.2 | How might we help applicants who are "less connected"? | Fairness |
| P1.3 | How might we improve diversity, equity, and inclusion in the selection process? | Fairness |
| P1.4 | How might we center the process around antiracism, justice, and anti-oppression? | Fairness |
| P1.5 | How might we ensure applicants aren't geographically excluded? | Fairness |
| P1.6 | How might we structure training for interviewers? I'm disappointed with how superficial, not thoughtful, and biased the process is. | Fairness |
| P1.7 | How might we center the communities we live in? | Fairness |
| P1.8 | How might we make the process more equitable for different professional backgrounds? | Fairness |
| P2.1 | How might we increase the transparency about the process? | Transparency |
| P2.2 | How might we get an honest understanding of program strength and weaknesses to help differentiate programs? | Transparency |
| P2.3 | How might we make the process better and more transparent for IMG/DO? | Transparency |
| P3.1 | How might we let applicants better show their creativity? | Applicant Experience |
| P3.2 | How might we give applicants the final say in where they train? | Applicant Experience |
| P3.3 | How might we help undifferentiated applicants not sure about surgery? | Applicant Experience |
| P3.4 | How might we match learning styles between programs and residents? | Applicant Experience |
| P3.5 | How might we minimize applicant overapplying? | Applicant Experience |
| P3.6 | How might we help students who lack mentorship? | Applicant Experience |
| P3.7 | How might we help applicants know what to ask? | Applicant Experience |

where the process occurs in a black box or is poorly standardized between institutions. The third theme of **applicant experience** captured all pain points surrounding the inability of applicants to use the process to showcase their talents, learn about the profession of surgery, and ultimately rank the best-fit program for them. Themes are displayed next to each pain point and solution in Tables 1 and 2.

*Prototypes*

We developed five potential prototypes that could help advance the previously proposed solution ideas while also providing some immediate value to current applicants. A complete list of prototypes is included in Table 3.

First, we felt that recording interviews could generate useful quality improvement data to improve standardization and reduce bias. This idea is easily feasible with the transition to virtual interviews. However, we anticipate privacy and regulatory hurdles in recording applicants. Therefore, we instead proposed filming simulated video interviews where one CoSEF member would play the role of interviewee, another would play the role of interviewer, and a third would run a debrief (R1). These videos would serve as a useful interview preparation resource for applicants while also allowing us to explore further research in the space of standardized interviews. This prototype would help us address both fairness and applicant experience. It would test the assumptions that applicants want resources to help learn interview skills and would be receptive to a simulated video.

Second, we proposed a standardized residency visual abstract

**Table 2**

Solution Idea Generation. Grammatical editing of solution ideas was performed to ensure readability with an emphasis on capturing the spirit of what was said by participants.

| Identifier | Solutions | Theme |
|---|---|---|
| S1 | Standardized questions to directly compare thought processes between applicants | Fairness |
| S2 | So many assessment tools but they don't necessarily predict 'fit', quality of residents | Fairness |
| S3 | Standardized virtual interviewing | Fairness |
| S4 | Gender/race concordance between interviewee/applicant | Fairness |
| S5 | Bias training for interviewers | Fairness |
| S6 | Video the interviews or transcribe/de-identify/audio only the interview (independent review) | Fairness |
| S7 | Interview session with the use of an interpreter | Fairness |
| S8 | Remove photos from applicants - but it will be hard to remember | Fairness |
| S9 | Get rid of match and pick another selection process like med school | Fairness |
| S10 | People don't have to worry about differential grad rates - diff backgrounds higher risk of not finishing | Fairness |
| S11 | Limit number of applications applicants can have to force programs to advertise | Fairness |
| S12 | Make the process free | Fairness |
| S13 | Identify and remove portions of the application that directly stimulate bias such as medical school | Fairness |
| S14 | Remove grades/scores/letters of recommendation from screening | Fairness |
| S15 | Better implicit bias training | Fairness |
| S16 | Universal review of all applications | Fairness |
| S17 | Common applications with essays | Fairness |
| S18 | Research to disprove common assumptions about DO/IMG | Fairness |
| S19 | Better data for more equitable treatment | Fairness |
| S20 | Having a central group determine the # of places you can apply to based on basic factors (to limit the high achieving applicants) | Fairness |
| S21 | Assign applicants to programs without giving them a choice | Fairness |
| S22 | Have "quotas" for certain "types" of applicants for interviews and match | Fairness |
| S23 | Bias training mandatory for all PD/APDs/EPCs | Fairness |
| S24 | Open/honest feedback that has repercussions for programs when it is "unfair" | Fairness |
| S25 | Have random humans/people off the street decide who will come/match | Fairness |
| S26 | Interview with normal humans or psychiatrists or someone else and not faculty | Fairness |
| S27 | Full sim or in life skills assessment, technical and non-technical | Fairness |
| S28 | Observe someone in the OR as their interview | Fairness |
| S29 | Perform scoping review on issues with fairness and transparency to provide evidence that problems exist | Fairness/ Transparency |
| S30 | When interviewees are talking to interviewers, they are given lots of information; quantify the legitimacy of the information in terms of the program | Transparency |
| S31 | Uber rating of applicant interviews | Transparency |
| S32 | Standardized interviewers and questions | Transparency |
| S33 | Need transparent information about the programs on benefits, EMR, maternity leave, affordable housing nearby, cost of living, food, housing | Transparency |
| S34 | Having some sort of document with all the program's info on it assembled by an outsider | Transparency |
| S35 | When you applied to med school, there was a side-by-side comparison you could make between schools. Easily compare and contrast. | Transparency |

**Table 2** (*continued*)

| Identifier | Solutions | Theme |
|---|---|---|
| S36 | Need transparency on do you consider DOs? Would you sponsor a J1 visa? | Transparency |
| S37 | Include how many interviews are offered, better assessment of their chances | Transparency |
| S38 | Programs could publish their algorithms for holistic review | Transparency |
| S39 | Could release the rank list? Tell each applicant where they fall? | Transparency |
| S40 | Being more transparent about the purpose of the interview, specific to each program | Transparency |
| S41 | Highly encouraging programs to share formula | Transparency |
| S42 | Transparency on the last time IMG was ranked to match | Transparency |
| S43 | What happens to prelims? | Transparency |
| S44 | Having a transparent statement about key characteristics for residents that will perform well (those who will need structure, those who like making their own way education wise) | Transparency |
| S45 | Have residents make the match lists/decide who will come instead of staff/PDs | Transparency |
| S46 | Increase transparency and improve interview experience (i.e., improve interviewers and gain more specific applicant/program information) | Transparency/ Applicant Experience |
| S47 | Give feedback to applicants during the interview. For example, If the PD said that you don't seem interested in a given city, you could have the opportunity to correct that. | Applicant Experience |
| S48 | Trained patients/other staff (nurses/OR staff/non surgeons) be involved in interviewing | Applicant Experience |
| S49 | Interesting question: what was the best feedback you got in medical school? | Applicant Experience |
| S50 | Old stodgy faculty shouldn't make the decision. Can we involve members of our community? Former patients? | Applicant Experience |
| S51 | Involve prominent community members | Applicant Experience |
| S52 | Pick up aspects of an applicant we don't think much about | Applicant Experience |
| S53 | Highlight reel like in sports but for applicants | Applicant Experience |
| S54 | Every program could also have a highlight reel | Applicant Experience |
| S55 | Highlight reel involving community members | Applicant Experience |
| S56 | Interview training for applicants | Applicant Experience |
| S57 | Interview training for interviewees | Applicant Experience |

**Table 3**

Summary of prototype ideas developed by participants.

| Identifier | Prototype | Theme |
|---|---|---|
| R1 | A video mock interview between CoSEF members with a third interview providing a debrief | Fairness, Applicant Experience |
| R2 | A standardized visual abstract template | Transparency, Applicant Experience |
| R3 | A list of ideal applicant questions | Transparency, Applicant Experience |
| R4 | A list of ideal interview questions | Fairness |
| R5 | Recommendation to take an implicit association test prior to conducting an interview | Fairness |

dissemination on modern social media platforms would allow individuals to view, share, and discuss the abstracts in real-time. This prototype would help us address transparency and applicant experience. It would test the assumptions that applicants want to be able to better compare programs and are willing to trust information on social media.

Third, we also proposed the creation of a list of recommended questions that applicants could ask interviewers (R3). Each question would have an attached justification and would be based on our insight as current residents - allowing applicants to politely but directly inquire about programmatic aspects that may not be covered in standard interview presentations. This prototype would similarly help us address transparency and applicant experience. It would test the assumption that applicants struggle to find meaningful questions to ask interviewers.

Fourth, we addressed the lack of interview standardization. Realizing that we do not have the authority to mandate a standardized interview, we proposed the creation of a list of potential standardized questions, and our justification or validity evidence, if available (R4). This list could serve as an accessible menu of options that each program can apply to its unique cultural context. This prototype would help us address fairness. It would test the assumptions that interviewers desire increased standardization and are willing to modify their interview style to accommodate standardized questions.

Finally, we addressed the complex problem of interviewer bias. We acknowledged that bias can be structural and that existing approaches - such as instituting a curriculum - would be time intensive and require significant buy-in. However, simply creating awareness of the interviewer's unconscious biases may limit the impact of implicit bias on applicant assessment [19]. Thus, we proposed to ask interviewers to voluntarily take a five minute implicit association test and review the result immediately prior to conducting interviews (R5) [20]. This prototype would help us address fairness. It would test the assumptions that interviewers believe they have implicit bias and are amenable to taking a five minute online test prior to interviewing applicants.

The first four prototypes can be posted online. We can measure their success by tracking views, link clicks, downloads, or engagement with the prototypes through comments. The fifth prototype - implicit association testing - would require more formal surveys of interviewers to see what percentage of users actually take the test and what percent of test-takers find that it changes their perspective on the interview.

## Discussion

In this paper, we demonstrated that a group of education-minded surgery residents could identify twelve current problems with the residency selection process, propose over fifty ideas to solve those problems, and suggest five prototypes to test those solutions within two hourlong sessions. By abstracting themes from our pain points and solutions, we show how design thinking can augment existing quantitative and qualitative approaches used in surgical education research. Our themes of fairness, transparency, and applicant experience parallel those discussed by others trying to improve the resident selection process. [11] To our knowledge, our paper represents one of the first perspectives on improving resident selection from a trainee viewpoint and is also one of the first to apply the design thinking approach to resident selection.

Our work builds on prior efforts to use design thinking within the context of surgical training. Previously, Chow and colleagues used a design thinking sprint to recognize that residents at their institution found wellness lectures and curricula less useful than free time and mentorship in improving well-being [21]. Some of these less favorable solutions may have been prescribed to residents without a design thinking-based exploration. Similarly, Mayeux and colleagues conducted design thinking sessions to creatively improve resident wellness at their institution [22]. Notably, they used techniques like journey-mapping and peer-interviewing to elicit pain points. They also found that providing residents with free time would positively impact wellness but met administrative hurdles when attempting to prototype this

template that would allow applicants to compare programs in a user-friendly manner (R2). While resources like FREIDA provide information on the program level, the information can be out-of-date and unreliable. Moreover, it may not include the information that applicants actually want to know and compare between programs. A visual abstract, iteratively developed with applicant feedback, can present high-yield information in a more digestible and accessible way. Furthermore,

initiative without high-level buy-in. This highlights the tension between creative ideation among residents and the ability to implement those ideas autonomously. Interestingly, qualitative feedback from participants suggested that engaging in the sessions improved wellness, suggesting that participation in the process may be independently valuable regardless of the results.

Our work differs from prior studies on resident selection in three meaningful ways. First, through divergent ideation, we believe we were able to come up with more "out of the box" solutions than have been previously reported in the literature. While others have suggested better implicit bias training and structured interviews, we were able to offer solutions such as making residency applications free and incorporating non-surgeons as interviewers. While these solutions may not be readily implementable today, it is valuable to bring them into the academic discourse. Second, our prototypes - while initially focused on more practical solutions - are more immediately useful than previously proposed solutions. For example, we do not have the authority to mandate programs to standardize interviews. However, the development of a recommended interview question guide (R4) would allow any surgeon interviewer who is interested in this approach to implement it without red tape. Third, while others have offered similar solutions in the past, to our knowledge, no one has documented the brainstorming process by which these solutions arose. By showing how the "sausage is made," we hope to highlight the inherent value of incomplete, impractical, and rough ideas that may never see the light of day, but direct us towards better solutions.

Every idea of ours may not be a winning solution - in fact, we know that this is quite unlikely. We do not claim that any of the solutions that we initially ideated or advanced into the prototyping stage will solve the problems of resident selection that we and others have highlighted. One of the biggest misconceptions about design thinking is that it is a way to structure a brainstorming session to solve a problem. Rather, the brainstorming session is simply a means to exercise one's creative muscle. It is the hope of design thinking that repeated practice in this manner will ultimately make more interesting solutions self-evident. At the same time, we think that the themes around which our problem statements and solution ideas cluster (fairness, transparency, and applicant experience) are worthy of further investigation. We believe that this will not only serve as a foundation for project work in our group, but can also inspire others to continue ideating from what we started. In the future, we plan to build out the prototypes we have proposed. In fact, CoSEF members have already begun working on offshoot projects based on our prototypes. Thus, our experience supports the use of the design process in rapidly allowing individuals to think creatively about a complex, yet flawed process that they have all personally experienced.

That being said, when reviewing participant responses during the sessions, we noted a few deviations from our established ground rules. It is important to make sure that pain points are broad and do not prematurely lead participants towards a solution. Upon review of our pain points, we noted one that was closer to a solution idea (P1.6 - How might we structure training for interviewers). With additional guidance, this could have been reframed in a problem oriented way (e.g., how might we reduce interviewer bias), for which structured training would be a possible solution. This type of reframing can be helpful to avoid pigeonholing participants into one solution too early in the process. Moreover, when first identifying solutions, it is important to not dismiss ideas outright. While this did not happen between members, in one instance a participant criticized their own idea (S8 - "Remove photos from applicants - but it will be hard to remember"). With additional coaching, we could emphasize that in the early ideation stage, it is impossible to know whether an idea is good, and even ideas with apparent flaws can serve as vehicles to previously inaccessible solutions [18]. On the other hand, participants did come up with bold ideas such as S12: "Make the application process free," which would have been less likely to emerge in a brainstorming format driven by constraints.

There are additional limitations of this work. While there is no rigid format for design thinking, participants were limited in the amount of brainstorming time provided. It is possible that even more creative ideas could have been generated had participants been given more time or if we conducted this brainstorming activity in a recurring fashion. Second, while we attempted to create a format that allowed everyone's ideas to be heard and eliminated groupthink, our initial development of pain points may have led to some anchoring, thereby potentially determining the eventual themes that emerged. Here, we had to strike a balance between removing all bias from the discussion while still creating a supportive structure for individuals practicing design thinking for the first time. Third, it is a fair criticism that the prototypes we have proposed may not achieve their desired outcome. For example, we have yet to test whether a standardized set of interviewer questions will (1) be viewed by interviewers, (2) be liked by them, and (3) ultimately reduce bias in interviewing. While we do not claim to have an answer to that question at this time, we merely offer that this prototype can help us study some of these questions faster and with less buy-in than traditional research approaches. Finally, CoSEF members who participated in this design thinking exercise are geographically diverse; however, we all come from academic programs, which may bias the pain points generated and prototypes constructed. Including people from more diverse backgrounds and non-academic programs may increase both the quantity and quality of ideas generated.

## Conclusion

Matching into surgical residency is a pivotal moment in the professional experience of a medical student. It is a process that requires years of hard work and effort. However, there are a number of pain points in this process that create additional stress for applicants and may interfere with the realization of this goal. Many of the structural issues within academic surgical education today could be improved by a fair, transparent, and user-friendly application process. We propose some ideas using the design thinking framework that may move us in the right direction. Moreover, we do so in a way that draws from our lived experience and is participatory, creative, and actionable. Students, residents, and surgeons interested in improving resident selection can replicate and expand on our approach or use this process for other issues within surgical education. Program directors and other stakeholders within surgical education are encouraged to pilot our proposed prototypes or similarly use this process to develop their own. We hope that some of these solutions can impact applicants in the near future. Beyond that, we hope that design thinking becomes a staple in the toolkit of future surgical educators.

## Ethics approval

None required.

## CRediT authorship contribution statement

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## Declaration of Generative AI and AI-assisted technologies in the writing process

There was no Generative AI used in the development of this manuscript.

## Declaration of competing interest

All authors agree to the content of this manuscript. No authors have relevant financial disclosures. Colleen McDermott participated in the APDS Task Force which is referenced in this paper.

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