

# Published Case Reports in Clinical Laboratory Education: A Function and Improvement Evaluation of an Innovative learning activity

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## ABSTRACT

**BACKGROUND:** Healthcare education must produce clinical laboratory professionals who are primed to engage in the challenges and complexities of clinical practice. Educational uses of published case reports may support this goal. However, there is very limited guidance in the literature.

**CONTENT:** We piloted a case report immersion activity among a cohort of undergraduate medical laboratory science students. Rooted in a theory of change model and in constructivism, the activity involved a sequence of 2 steps: critical appraisal using the Case Report Guidelines followed by reflection. The approach considers that case reports model complex professional behavior, contextualize professional experience, and promote reflective thinking about clinical practice. We administered pre- and postactivity questionnaires to evaluate the activity's function and improvement potential and student perceptions of benefit.

**SUMMARY:** Based on student feedback, the activity functioned as intended. However, through the questionnaire we identified several instructional and activity improvement opportunities. The case method approach that was used has implications for curricular planning and

future evaluations. Additionally, this report supplements the limited guidance on the use of published case reports in healthcare education.

**ABBREVIATIONS:** CARE - Case Report Guidelines, MLS - medical laboratory science, RR - risk ratio.

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## INTRODUCTION

As a type of research and evidence, case reports inform healthcare.<sup>1,2</sup> Case reports are descriptive observational studies that provide detailed after-the-fact observations of real-world clinical scenarios for a patient in a particular context wherein novel features are present. Although the educational value of case reports has been broadly asserted,<sup>2,3</sup> that value is usually presented as self-evident rather than empirically demonstrated. Moreover, detailed pedagogical uses of published case reports are largely undocumented in the literature. As a result, published case reports may have unrealized potential in curricular planning and case method activities, but this potential needs to be demonstrated.

## Objective

Healthcare educators must prime healthcare students to anticipate the challenges, uncertainties, and complexities of practice and to engage in communities of practice. To explore the potential of published case reports, we developed a structured immersion process based on our premise that case reports model complex professional behavior, contextualize professional experience, and promote reflection on healthcare practice. In this report, we describe a 2-step structured case report immersion activity that was piloted with a cohort of undergraduate medical laboratory science (MLS) students at Rutgers University. Additionally, we provide findings from pre- and postactivity questionnaires. The questionnaires served to evaluate the activity's function and improvement potential and student perceptions of benefit.

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## MATERIALS AND METHODS

This quality improvement study was reviewed and approved as “exempt” by the Rutgers University Institutional Review Board (study ID: Pro2022000001).

### Theory of Change Model and Theoretical Grounding

We express the 2-step case report immersion activity and its intended effects in the Figure 1 theory of change model that was developed by 2 authors (M.R. and A.S.). The model is based on the constructivist learning paradigm,<sup>4</sup> and the model draws also on the following from Fraser and Greenlagh (2001): (a) the need to focus on pedagogical processes to produce health professionals who are not only competent but also “capable” (ie, able to adapt to change, generate new knowledge, and continually improve performance) and (b) the purported utility of case-based discussions in constructivist educational processes (although Fraser and Greenlagh do not provide concrete guidance or examples).<sup>5</sup> Finally, the model also draws on the Learning-Transfer Evaluation Model<sup>6</sup> and on the reflective practice literature.<sup>7</sup> The assumptions identified in our model—which depict the problem that requires change—are based on observations by the primary instructor (M.R.) for the MLS course in which the activity was piloted.

Examining the proposed mechanisms of change in the model, critical appraisal is (by its nature) an intensive process that the instructor can leverage for guided reflection on professional practice. Germane to this perspective,

critical appraisal has been described, specifically, as a constructivist activity, and therefore it can promote recontextualization of knowledge.<sup>8</sup> For example, critical appraisal may facilitate subsequent reflective practice in novel ways that expand student understanding of a healthcare profession. Additionally, reflection is described as “a process that needs scaffolding”<sup>9</sup>—conveniently, in this mutual relationship, scaffolding for reflection is afforded by the process of critical appraisal. To provide added structure for reflection on healthcare practice, the theory of change model links case reports to the following general themes: quality and safety, culture and norms, action and reasoning, decision and change, and outcomes and lessons learned.

### Pedagogical Process and Activity

As indicated in the theory of change model, the case report immersion activity is a 2-step process: critical appraisal followed by reflection. A student worksheet facilitated both steps (see Appendix for the critical appraisal worksheet). For the activity pilot, the case report immersion activity occurred (a) in teams of students, consisting of 5–6 students per team among a class of 28 students, and (b) over 2 in-person class sessions.

#### Case report immersion, step 1

For case reports to optimally meet their roles as a type of research and evidence, the quality of the case report must be assured. The Case Report Guidelines (CARE) provide a tool to assess quality (ie, critically appraise) in terms of completeness of reporting.<sup>10</sup> For step 1 of the case report immersion activity, we used a slightly modified version of

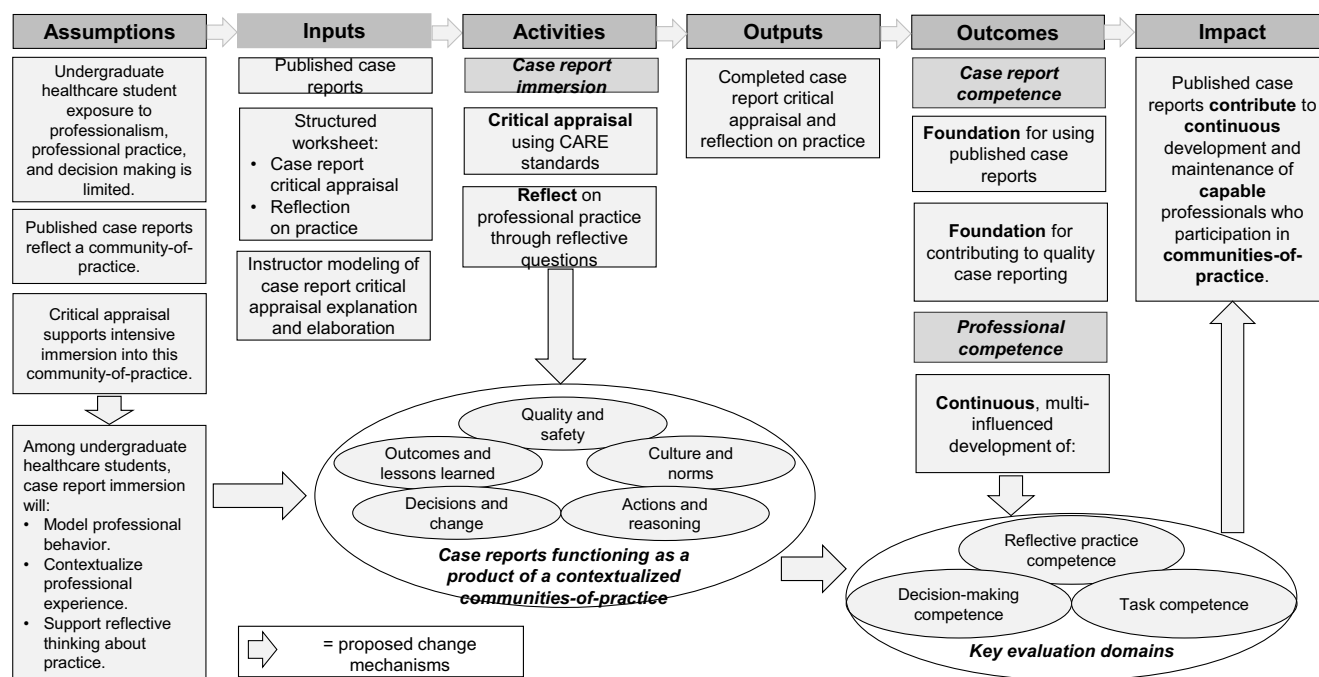


Figure 1. Theory of change model.

the CARE reporting standards. These modifications were made to support question clarity for the undergraduate student cohort and make clear the linkage of the questions to vulnerabilities in the total testing process and to quality improvement. The specific adaptations made to the original CARE checklist are described in the Appendix.

### Case report immersion, step 2

Following the initial immersive process of critical appraisal, we guided students to reflect on the challenges, practices, decisions, actions, outcomes, and lessons portrayed in the case report. Reflective questions used in step 2 of the case report immersion activity are as follows:

- What did the case report authors encounter that was unusual, uncertain, or new to them?
- What decisions were made by the case report authors and why were those decisions needed?
- In what ways do you think the study authors were capable professionals?
- Briefly indicate which parts of the case report correspond with the following concepts: quality and safety, culture and norms, actions and reasoning, decision and change, outcomes and lessons learned.

### Activity implementation

The process of implementation of the 2-step case report immersion activity is depicted in Figure 2. All teams were assigned the same clinical laboratory–relevant published case report, Yu et al (2018).<sup>11</sup> This case depicts a patient encounter that is contextualized to vulnerabilities in the total testing process, and therefore to the challenges and uncertainties, and opportunities for improvement that are inherent to all of healthcare practice. In other words, the case depicts “capable” healthcare professionals

(definition for capable healthcare professional above), and the case provides an exemplar of (and is a product of) a well-functioning community of practice.

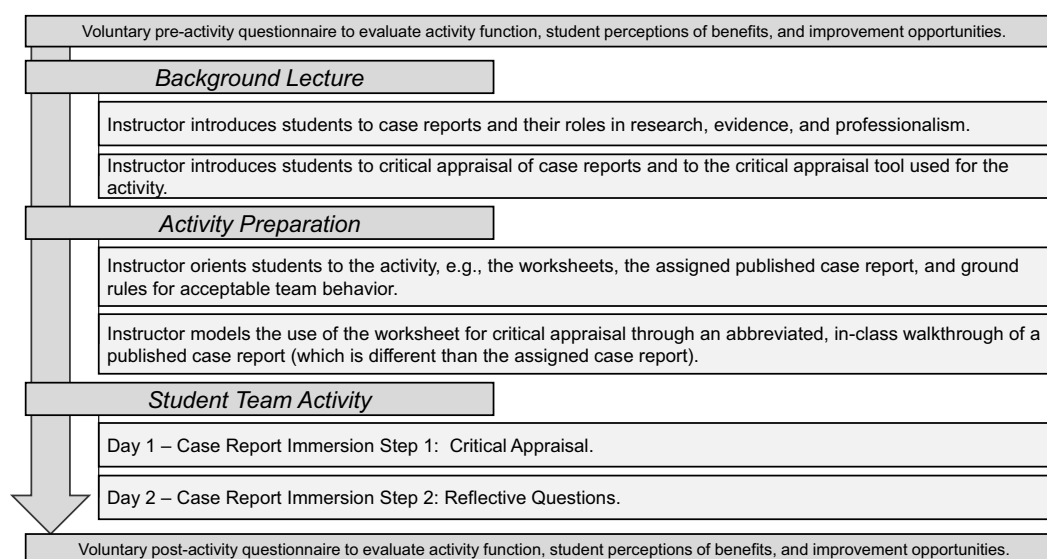
### Activity assessment to support activity quality improvement

We administered voluntary, anonymous pre- and postactivity questionnaires to the students using Qualtrics XM (<https://www.qualtrics.com/>). Questions were developed by 1 author (M.R.), with feedback from co-authors to improve question clarity and relevance. Pre- and postactivity questions are detailed in the Appendix.

For both the pre- and postactivity questionnaires, basic descriptive statistics ( $n$ , %) are reported in the Results section. For the free-text entry questions, we analyzed student responses through the method of content analysis, specifically through the methods of descriptive coding and concept coding.<sup>12</sup> Descriptive coding “assigns basic labels to data to provide an inventory of their topics” and concept coding “extracts and labels big picture ideas suggested by the data.”<sup>12</sup> Content analysis was performed by one author, M.R., with review by J.S.P.

## RESULTS

Although specific demographic data were not collected for the student cohort, the cohort consisted of undergraduate students (2021–2022 cohort cycle) in the baccalaureate MLS program at Rutgers University (<https://shp.rutgers.edu/clinical-lab-and-imaging-sciences/bachelor-of-science-medical-laboratory-sciences/>). The activity was implemented, specifically, in the Clinical Chemistry II course, which uses case methods in various ways. The Yu et al (2018) published case report was selected to be relevant, in part, to the clinical chemistry knowledge base,



**Figure 2.** Activity implementation.

and for having other attributes that were described above.<sup>11</sup>

Twenty-two of 28 (78.6%) students completed the preactivity questionnaire, and 19 of 28 (67.9%) students completed the postactivity questionnaire. Since the preactivity questionnaire served to gather initial perspectives (as well as to prime students' minds for the case report immersion activity), we do not consider the loss of 3 students in the postactivity questionnaire as impactful as the reverse situation. Additionally, pre- and postactivity data were not statistically compared.

### Preactivity Questionnaire Findings

Results for the Likert-type preactivity questionnaire are presented in Figure 3.

In general, students self-reported a high understanding of concepts that would be subsequently presented during the background lecture for the 2-step case report immersion activity (see Figure 2). Furthermore, the students self-reported prior awareness of the complexity of clinical practice and awareness of the relevance of case reports to communities of practice. However, the 3 items with the lowest agreement (items 1, 3, and 9) suggested student hesitancy regarding (a) the utility of case reports in clinical practice (items 1 and 9) and (b) whether students had the requisite knowledge to engage other with lab professionals, eg, in a community of practice (3). This suggests that although we should value student self-reported confidence and leverage that confidence in terms of student motivation and promotion of a growth mindset,

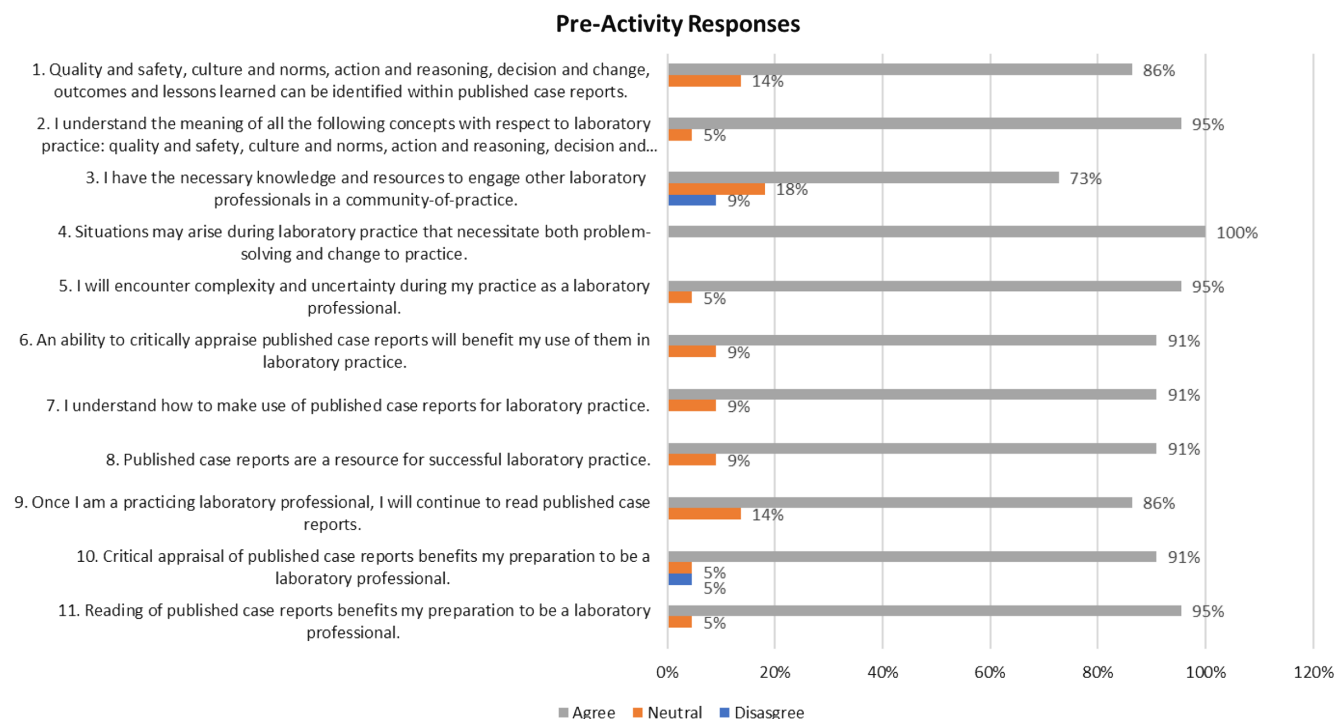
instructors should be realistic about students' likely understanding and plan content lessons accordingly.

Students were also asked to provide a free-text response to the following prompt: "Briefly describe what being a capable laboratory professional means to you?" Content analysis of student responses to this question applied the following 8 a priori themes that were derived from both (a) the definition of a "capable" healthcare professional<sup>5</sup> and (b) competence domains identified by Thalheimer.<sup>6</sup> The a priori themes used for content analysis of student responses were as follows: adapt to change, generate new knowledge, continual improvement, reflective practice competence, decision-making competence, task competence, collaboration, and communication. Refer to Table 1 from the preactivity questionnaire.

These results suggest that, prior to the background lecture, the students' understanding of professionalism is heavily centered on task competence, whereas other themes—such as communication, adapting to change, and the ability to generate new knowledge—feature much less in students' understanding of capable professionalism. Using these findings, the instructor can, in the future, expand the activity's background lecture to discuss those themes, which are essential to a well-functioning community of practice.

### Postactivity Questionnaire Findings

Findings from the postactivity questionnaire are grouped into 4 topics: activity challenges, support to students, activity improvement, and benefits.



**Figure 3.** Responses to the preactivity Likert-type questions.

**Table 1.** Themes of student responses to “understanding of capable professional” from the preactivity questionnaire

Theme	Frequency (% of Student Responses)
Task competence	77%
Reflective practice competence	50%
Continual improvement	41%
Decision-making competence	36%
Collaboration	18%
Communication	9%
Adapt to change	5%
Generate new knowledge	0%

### Topic 1: activity challenges

We assessed students’ perceived challenges when applying (as part of a team) the following general healthcare concepts during step 2 of the case report immersion activity: quality and safety, culture and norms, action and reasoning, decision and change, and outcomes and lessons learned. In terms of application difficulty, students were asked to rank each of these general healthcare concepts as 1 to 5 (1 representing most difficult to apply, and 5 representing least difficult to apply). Ranking of perceived application challenge is as follows:

- Culture and norms (most students ranked as “1,” most difficult to apply)
- Action and reasoning (most students ranked as “2”)
- Quality and safety (most students ranked as “3”)
- Decision and change (most students ranked as “4”)

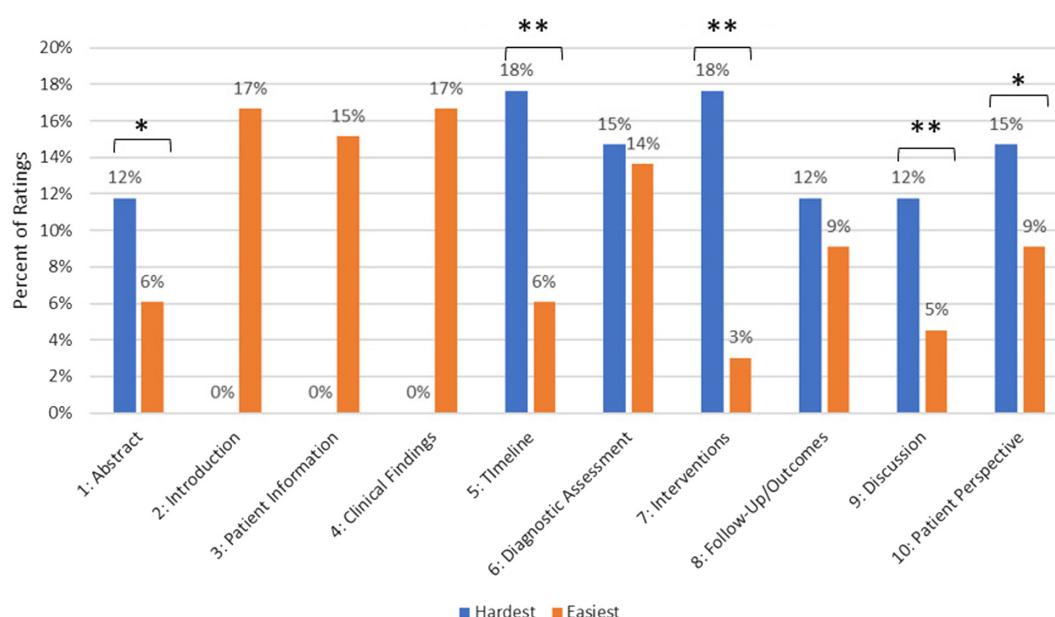
- Outcomes and lessons learned (most students ranked as “5,” least difficult to apply)

This finding suggests an opportunity for the instructor to prioritize explanation of these healthcare concepts and their application to the assigned case report.

Next, to assess perceived challenges when applying the CARE critical appraisal question as a team, students were asked: “Which of the 10 critical appraisal questions were the hardest, and which were the easiest, for your team to understand and apply?” Helpful in planning this assessment, the CARE reporting standards already provide a theme for each critical appraisal question, as follows: abstract, introduction, patient information, clinical findings, timeline, diagnostic assessment, interventions, follow-up/outcomes, discussion, and patient perspectives.

To assess student responses to this question, we first generated a clustered bar chart based on the student responses. This chart, shown in Figure 4, demonstrates (a) variations in the percentage of difficult vs easy responses and (b) patterns for each theme’s relative rating as difficult vs easy. Given that 2 separate questions were asked—one about critical appraisal questions that were the hardest to apply, and one about the easiest to apply—a finding of a mix of patterns may be anticipated, since each student may be expected to have varied views about the challenges encountered, independent of their team member’s perspectives. Additionally, teams may be expected to experience the challenges differently than other teams.

In Figure 4, some CARE themes were rated only as easy, whereas other themes demonstrate a varying “mix” (across students) of hard and easy ratings. To differentiate patterns that are a “mix,” we applied the statistical



**Figure 4.** CARE theme application difficult ratings with overlay of risk ratios \* = More Difficult; \*\* = Most Difficult.



approach of *risk*, ie, the risk of students selecting a CARE theme as “hardest” to apply compared to “easiest” to apply. We express this as the risk ratio (RR). Pattern differentiation, based on the RR of easy vs hard, is as follows:  $RR < 1.5$  = “Mixed: Balanced,”  $1.5 < RR < 2.0$  = “Mixed: More Difficult,”  $RR > 2.0$  = “Mixed: Most Difficult.” For example, if a CARE theme has an RR of 2.0, that means that the students were 2 times more likely to indicate that applying the theme was hardest rather than easiest to apply during critical appraisal.

Interpretation of Figure 4 data is provided in Table 2. To assist interpretation, the “More Difficult” and “Most Difficult” categories were collapsed into 1 group, labeled “Difficult.” To also assist interpretation, “Balanced” was renamed “Moderate.” The interpretive comments provided in Table 2 will guide the instructor’s activity background lecture when explaining the use of the 10 critical appraisal questions and when modeling use of the questions.

### Topic 2: support to students

Next, we assessed what would further support student ability to independently critically appraise case reports

in the future: “Briefly describe what would further support your ability to apply the critical appraisal approach on your own” Themes identified from the content analysis of student responses to this question were: (a) more background instruction (50%), (b) more student practice (33%), (c) more instructor analysis (21%), and (d) opportunity to compare effort to that of the instructor (7%). Application of these findings will be further described in the Discussion section.

### Topic 3: activity improvement

Next, the postactivity questionnaire queried students’ suggestions to improve the case report immersion activity. One author (M.R.) performed content analysis of student responses to the question of activity improvement. Table 3 provides findings from this content analysis.

### Topic 4: benefits

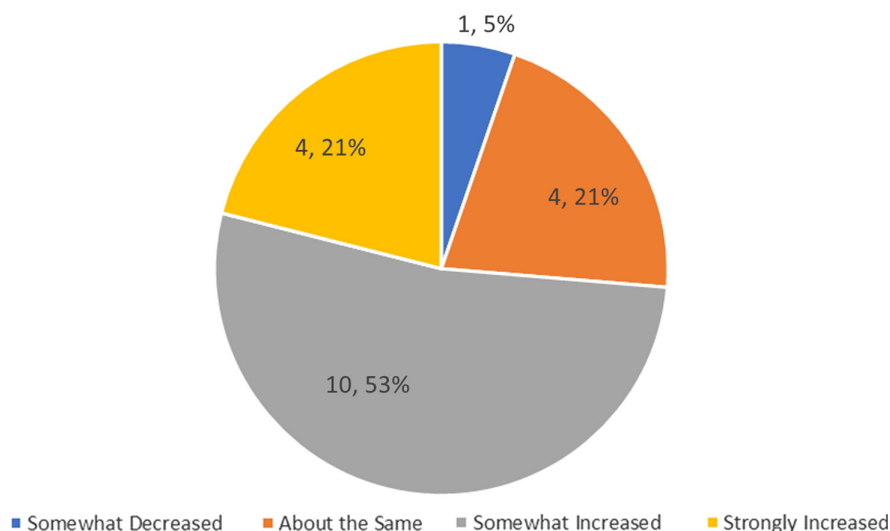
Next, we assessed students’ perceptions on the benefits of the case report immersion process with the following questions: “In the preactivity questionnaire, you evaluated the following statement for yourself: an ability to critically appraise published case reports will benefit my use of them

**Table 2.** CARE application difficulty types and interpretive comments

Critical Appraisal Theme	Application Difficulty	Interpretation
Introduction Patient information Clinical findings	Easy	Most students found these critical appraisal themes easy to apply. The instructor does not need to modify explanatory approach.
Diagnostic assessment Follow-up/outcomes	Moderate	Many students found these critical appraisal themes difficult to apply. The instructor should develop additional explanatory resources that students can refer to as needed.
Abstract Patient perspectives Timeline Interventions Discussion	Difficult	Most students found these critical appraisal themes difficult to apply. The instructor should spend more time discussing these themes and their application during the primary lecture and during the critical appraisal walkthrough activity. Additionally, Figure 4’s “more” vs “most” categories of difficulty can inform how much time is spent discussing these critical appraisal themes.

**Table 3.** Content analysis of student responses to ways to improve the case report immersion activity

Improvement Opportunity	Frequency
In-class comparison of each team’s findings	23%
In-class comparison of each team’s findings with that of the instructor	23%
More instructor examples	15%
More conceptual background instruction	15%
Instructor explanation of the assigned case report prior to activity	15%
Separate teams from each other (to reduce noise and distraction)	8%
Form smaller groups (activity involved groups of 5–6 students)	8%
Conduct both steps of the case report immersion activity on the same day (activity was split over 2 days)	8%
Provide the set of reflective questions in advance (questions were provided just prior to step 2 of the activity)	8%
Combine teams for step 2 of the activity (for more robust discussion)	8%



**Figure 5.** Change in perception on the benefit of case report critical appraisal to laboratory practice.

in laboratory practice. How has your opinion about this benefit changed following the activity?" Perceptions of the change in benefit are presented in Figure 5.

Overall, this finding suggests that the activity functioned as intended and that the students found it useful.

Next, the postactivity questionnaire explored how the 2-step case report immersion activity helped students to observe professional behavior and activities of laboratory communities of practice in laboratory medicine. Furthermore, it explored the question of how the activity helped students to advance their understanding of the complexities and uncertainties that they may encounter during everyday laboratory practice. Figure 6 summarizes student perspectives on the following prompts: "the 2-step case report immersion activity helped me to observe professional behavior," "the 2-step case report immersion activity helped me to further understand what it means to be a 'capable' laboratory professional," "the 2-step case report immersion activity helped me to explore the activities of a laboratory community of practice," and "the 2-step case report immersion activity helped me to further understand that I may encounter complexity and uncertainty during everyday laboratory practice."

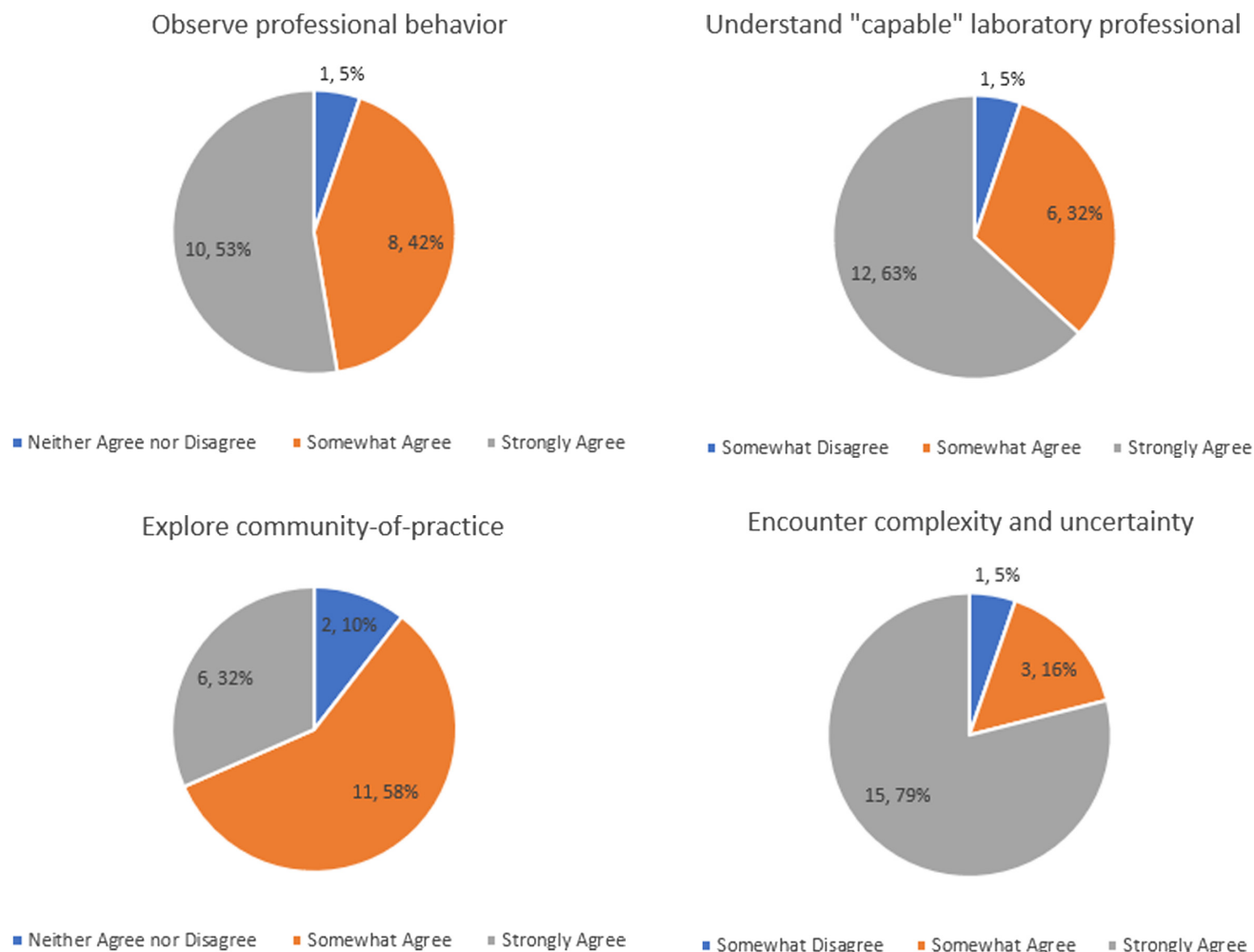
## DISCUSSION

Explicit use of published case reports as part of the case method of learning in healthcare education is largely undocumented. Supporting this claim, Fraser and Greenhalgh indicate that there has been "remarkably little formal research into how stories [ie, published case reports, as a type of descriptive observational research] might be used more effectively in professional education and service development."<sup>5</sup> In this report, we explored the expanded potential of published case reports in healthcare education by piloting an innovative 2-step case report

immersion activity contextualized in a theory of change (Figure 1). This report centered on (a) activity description so that others may adopt or adapt the approach, (b) an estimate of activity function and usefulness, and (c) understanding ways to improve the activity.

Findings from this function and usability pilot project will be used to improve activity implementation in the future. Specifically, the background lecture will include additional conceptual discussion, with focus on those aspects of critical appraisal and reflection that the students identified as most challenging. Additionally, background instruction on the 10 critical appraisal questions will be prioritized according to Table 2 findings. Furthermore, the instructor will (a) divide the background lecture over 2 days, with the second day affording additional instructor examples; (b) conduct both steps of the case report activity on the same day; (c) provide a high-level overview of the assigned case report just prior to critical appraisal; (d) provide a model critical appraisal for comparison after the activity; (e) form smaller student groups for activity step 1 (critical appraisal); and (f) combine groups for activity step 2 (reflection). The smaller initial groups may support focused analytical participation by all students in the group, whereas combining groups during reflection may spur wider reflection by drawing on multiple student perspectives.

A limitation of this project is that it does not examine the effects of the case report immersion approach on student competence or capability. However, this project's theory of change model suggests multiple robust evaluative opportunities, such as opportunities to evaluate effect on decision-making competence, task competence, and reflective practice competence. Following activity improvement, further evaluation in the context of the project's theory of change model can occur.



**Figure 6.** Student perspectives on case report immersion benefit to understanding of professionalism, community of practice, and practice complexity.

## CONCLUSIONS

This piloted approach to an educational use of published case reports fills a gap in the literature: a lack of studies on the use of published case reports in healthcare education. Rooted in a theory of change model and constructivist pedagogy, the activity involved a sequence of 2 steps: critical appraisal using the CARE guidelines followed by use of reflective questions. Based on student perspectives, the case-based activity functioned for its intended goal, but several opportunities for improvement were identified. Using case method activities that leverage published case reports, clinical laboratory science education—and healthcare education in general—has an added means to expand the repertoire of learning activities.

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