Work in Progress: Evaluating Identified Engineering Needs through BME Student Debriefing Sessions after Clinical Immersion

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Background

Biomedical engineering (BME) immersion programs aim to provide high-impact experiences to engineers-in-training, often to reinforce or augment engineering design skill development. Specifically, clinical immersion experiences can provide BME students a structured way to realize how engineering design theory can be applied in a practical setting [1]. Clinical immersion can also amplify aspects of BME design that may not be achieved solely in the classroom, such as user need identification or awareness of socioeconomic factors in healthcare [2]. Assessing how students identify user needs or report their awareness of socioeconomic factors in healthcare can be challenging. Thus, a need exists to develop and share evidence-based practices with BME educators, toward the development of student activities that provide effective ways to identify, reinforce, and monitor student learning after immersion experiences.

Reflection and debriefing are two approaches that have been used with a variety of learners in clinical settings [3], [4]. Reflection is an approach used to evaluate how learners document their observations and conceptualize how they can implement [7] these observations in their design practice. In a previous work, we qualitatively evaluated student reflections after clinical immersion experiences through prompts structured via the DEAL model for critical reflection. This work found that students identified source themes that were related to gender (9%), race (21%), age (20%), and health (25%) when reporting on observed demographic or health-related trends during their clinical rotations [5]. Student reflections did not involve active engineering design, making it difficult to link these finding to how students would consider socioeconomic factors during the design process itself.

Debriefing is another approach that can be used after clinical immersion to collectively question assumptions when reflecting on lived experiences [6]. Informal debriefing, specifically, is a method that has been implemented in training nurses, educators, and medical professionals and is a documented way of providing constructive feedback during a clinical learning experience [6], [7]. Our current work aims to investigate if students surface similar demographic or health-related trends during informal debriefing sessions that follow their clinical experiences, specifically when students are asked to evaluate their own user needs statements. Informal debriefing sessions following BME student clinical immersion experiences may provide a meaningful way to demonstrate how students can apply their own awareness of socioeconomic factors in healthcare when identifying clinical user needs.

Program Overview and Participants

Our seven-week clinical summer immersion program combines clinical rotations, multi-format instruction, and team-based design to build student design skills and awareness of socioeconomic factors in healthcare [2]. BME undergraduates can apply to participate in our program as rising 2^{nd}-, 3^{rd}-, or 4^{th}-year students; therefore, participants have all completed, at a minimum, required first-year engineering coursework. Recruitment occurs in early spring (January-March) and is advertised via email and in classes that span all rising 2^{nd}-4^{th} year BME students. Alongside teaming and level-setting engineering design activities, the first week of the program invites

academic and medical professionals to lead discussions with students on the topics of US city and state demographics, the innerworkings of hospitals and clinics, and healthcare system structure and stakeholders. Following this, students rotate through different clinical settings for 4-5 weeks with required weekly reflection journaling. Each week, students also have virtual check-in sessions with the teaching assistant (on Tuesdays) and with the instructors (on Thursdays). The purpose of these weekly check-ins is to address any issues, check on reflection journals, stimulate discussion and ensure readiness for the next rotation. Finally, all participants reconvene for a final week of reflection, informal debriefing, and designing in teams.

In four years (2021-2024), our program has included a total of forty-four undergraduate BME participants including 6 rising 2nd-years, 13 rising 3rd-years, and 25 rising 4th-years. This work is approved by the Purdue University IRB Protocol 2024-619.

Informal Debriefing Session Descriptions and Methods

Two debriefing activities were designed and implemented to facilitate informal debriefing with summer immersion students after they completed multiple weeks of clinical rotations. Each debriefing session runs approximately 60 minutes. The first activity, a clinical immersion debrief, guided students through ten short, individual prompts: *Most Interesting Procedure, Was a Fun Experience, Most Educational about Medicine, I Had No Idea About, Favorite Medical Professional, Wish I Had More Time Here, Was Really Boring, Most Educational about Society, One Thing I Learned About BME, and I Want to Know More About*. Participants had access to their reflection journals and were given 10-15 minutes to provide written responses to each of the prompts. A 45-minute group discussion followed. Written responses (n=35) from 2022-2024 participants were collected, transcribed to Microsoft Excel for analysis. Student responses were qualitatively analyzed in two ways: (1) for demographic source themes related to gender, race, age, an/or health and (2) where their self-reported gains in education about society occurred.

The second activity, a needs identification debrief, asked students to list up to three identified user needs that specifically involve a socioeconomic factor to consider during design from their clinical immersion experiences. Student participants (from 2021-2024) were given 15 minutes to organize their responses electronically. A 45-minute group discussion followed. Typed responses from forty-three students were collected and transcribed to Microsoft Excel for qualitative analysis. Both debriefing activities happen on the first day of the last week of the program.

Preliminary Data

Clinical Immersion Debrief Activity: The clinical immersion debrief activity proved to be a way to capture student input on beneficial experiences and potential areas of program improvement. As an example, we learned that 40% of participants reported they wished they had more time in orthopedics or prosthetics. This debriefing activity also allowed students an opportunity to share of rotational experiences where others may not have visited which ended up reinforcing themes that surfaced during group discussions. The prompt, *Most Educational about Society*, was the most relevant of the ten prompts to learn if students surfaced economic and/or societal considerations during this debriefing session. Of the thirty-five responses, sixteen (or 46%) identified gender (n=1), age (n=5), health (n=5) or other (n=5) source themes that singled out a demographic factor. Students reported their learning about society occurred during the following program aspects: outreach clinic/hospital (20%), Physical Medicine & Rehabilitation (PM&R)

rotation (20%), one-on-one discussions with medical professionals or patients (14%), clinical discussions about insurance (9%), and guest lecturers (6%).

Not all students rotated through PM&R; in fact, we found that 35% of students (7 of 20 students with a PM&R rotation) reported this experience as most educational about society. Students commented "…*it taught people how to regain important everyday chores to be integrated back into society*" and "*…often, patients had to prioritize additional factors above their personal health*". This information has encouraged us to schedule more student rotations with PM&R.

Needs Identification Debrief Activity: One hundred ten user needs were identified during this activity from the students that participated (n=43). Seventy-six (or 69% of total needs reported in this activity) user needs were identified as identifying a socioeconomic factor or outcome. Table 1 summarizes emergent source themes from student identified user need statements. Forty-four user needs (or 57%) identified a demographic source theme with age-related themes identified the most (n=23, 30%) followed by health-related (n=9, 12%), other (n=7, 9%), gender-related (n=3, 4%), and race-related (n=2, 3%).

Table 1: Emergent Source Themes from Student User Need Statements

Source Theme	**Example Student Explanation**	**N (% of Needs)**
Family/guardian support limitation	*"This is a real struggle for families who have to travel far distances, don't have reliable transportation, don't have the ability to take an entire day off of work, or have other commitments in the morning such as needing to get other kids to school."*	15 (20%)
Patient need interferes with work/school	*"The ability to dilate eyes faster could get more patients in and out of the clinic faster and that can get people back to work sooner."*	8 (11%)
Cost burden or insurance limitation	*"This can affect the patients who cannot afford multiple surgeries and the time it takes to recover from these surgeries"*	13 (17%)
Improved health outcome for identified demographic	*"Better post-op care will lead to lower infection rates and less time spent in the hospital"*	19 (25%)
Language and/or education barrier	*"Patients are not fully and accurately informed of the surgery and what it means for them or their child, which can lead to procedures being delayed or not done entirely"*	14 (18%)
Limited access to technology or care	*"Certain communities don't have access to these devices"*	3 (4%)
Other	*"where you live determines how many specialists you have access to and thus may decrease or increase wait time"*	4 (5%)

Future Directions

In summary, clinical immersion programs can contribute to student awareness by providing community-engaged experiences rich with discussion of health needs, disparities, and proposed actions. A limitation to our current approach is that our debriefing sessions occur after all clinical immersions are completed. However, our work aims to employ informal debriefing methods, such as those used in medical professional training, to provide BME students with opportunities to demonstrate awareness of socially conscious design factors. Further, our findings may guide BME educators in the development of similar activities for engineers-in-training.

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