


**EDUCATION REPORT**

# Trainee perspectives of COVID-19 impact on medical genetics education

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**PURPOSE:** The SARS-CoV-2 pandemic abruptly altered medical education and clinical care. This work evaluates trainee perspectives of the impact of the pandemic on medical genetics education.

**METHODS:** A Qualtrics survey was sent to physician trainees who rotated in genetics before or midpandemic. Questions assessed patient care, didactic education, and competency in multiple domains. Number of clinic visits completed by trainees were collated through review of documentation.

**RESULTS:** Twenty-three rotating residents completed the surveys. Five of the pediatric residents completed the elective during the pandemic. All residents participated in virtual care during the pandemic, and rotating residents reported an improvement in self-assessed competency in multiple domains. Potential weak areas of education midpandemic included dysmorphology and genetic counseling.

**CONCLUSION:** Residents on a genetics elective can gain crucial skills and knowledge even when the rotation is in a primarily virtual format. Supplemental dysmorphology and genetic counseling education may improve remote educational experiences. Further research across institutions may deepen understanding of the impact of the pandemic on education in genetics.

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## INTRODUCTION

The onset of the SARS-CoV-2 pandemic (with its respective infection, coronavirus disease 2019, [COVID-19]) resulted in abrupt changes in clinical care and medical education. Within days, in-person meetings were canceled and virtual care initiatives took root. These rapid changes have had a profound impact on medical education, but trainee perception of these changes has not yet been widely evaluated.

Multiple medical and surgical specialties have shared their experiences with adjusting to the COVID-19 pandemic. Given the midpandemic drop in elective surgical cases, surgical specialties have had to modify training the most drastically.<sup>1–3</sup> In pediatrics there have been noted impacts on the direct interaction with patients and colleagues, traditional educational experiences such as bedside rounds and noon conferences, and uncertainties regarding the clinical competency of graduating residents.<sup>4</sup> Strategies to address the impact of the pandemic have focused on virtual care, self-directed learning, and online curricula utilization.<sup>3,4</sup>

Geneticists have also begun sharing successes and resources on social media platforms, email listservs, and in the medical literature.<sup>5</sup> In addition to the shift of didactic education to online modalities,<sup>6</sup> there has been the concomitant ramp-up in virtual care. Thus, both teaching methods and the way medicine is practiced have had to rapidly adapt. Many elective opportunities were halted or have shifted to an online curriculum.<sup>7</sup>

Our team aimed to determine the impact of the pandemic on physician trainees rotating in medical genetics. At Michigan Medicine, virtual care was in the process of being broadly implemented prior to the onset of the pandemic. A rapid ramp-up occurred over the course of weeks. This required restructuring the pediatric genetics rotation for pediatric resident rotators and genetics trainees. With the cessation of most in-person visits, residents were assigned to virtual visits (most often video visits) with genetics attendings. This survey-based work aims to assess

the preliminary impact of COVID-19 on the educational experience in pediatric genetics.

## MATERIALS AND METHODS

The Pediatric Genetics elective at Michigan Medicine made several modifications to elective education at the start of the COVID-19 pandemic given its negative effects on available in-person clinical opportunities. Most patient encounters were transitioned to virtual visits, although occasional in-person inpatient consultations were available. Additionally, a virtual lecture series was provided to rotating residents by division faculty covering topics in clinical genetics, dysmorphology, molecular genetics, and biochemical genetics. Previous biochemical and molecular laboratory experiences included tours of the labs and dedicated time with lab directors reviewing reports and interesting cases. While these laboratory experiences were canceled following the COVID-19 pandemic, molecular and biochemical genetics-specific lectures were added to the virtual lecture series.

To assess the impact of the COVID-19 pandemic on trainee education a Qualtrics survey was distributed in June 2020 to pediatric residents who had previously completed a clinical elective in Pediatric Genetics from July 2018 to June 2020. This included residents that rotated pre- and midpandemic. The two residents rotating in March 2020, the month the national emergency was announced in the United States, were not included in the survey given inconsistencies in scheduling during that month. Questions included assessment of the number of in-person visits, inpatient consultations, and virtual visits (includes video and phone visits) as well as trainee satisfaction with varying types of clinical care and learning experiences. The average number of clinics per work week (Monday through Friday) on the rotation and patients seen per work week on the rotation by each rotating resident were calculated by reviewing resident-specific

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calendars, actual clinic schedules and encounter documentation. Unpaired *t*-tests were used to compare the number of clinics per week and the number of patients per week on average seen by residents pre- and midpandemic. Likert scores were determined for various questions by assigning a value to question responses as follows: Very poor = 1, Poor = 2, Average = 3, Good = 4 and Very good = 5.

## RESULTS

The survey was distributed to 28 pediatrics and combined internal medicine–pediatrics residents with a total of 23 (82%) completing the survey, with 2 in postgraduate year 1 (PGY-1), 10 PGY-2, 10 PGY-3, and 1 PGY-4. All residents completed a 3- or 4-week elective rotation in pediatric genetics (Table 1). Nineteen of 23 residents (83%) participated in in-person clinic visits during the elective with the 18 rotators on the elective before the pandemic completing all visits in-person. All rotators (23/23) participated in inpatient consultations. There was no significant difference between the number of clinics (clinics defined as a half-day session) residents participated in pre- and midpandemic with prepandemic residents in 1.8 clinics per week and midpandemic residents in 2 clinics per week ( $p = 0.157$ ). There was a significant difference in the number of outpatients seen per week with prepandemic residents seeing 3.1 patients per week and midpandemic residents seeing 2.2 patients per week ( $p = 0.002$ ). Five of 23 residents (22%) were involved in virtual outpatient visits during the elective; corresponding with the five respondents who were on the elective after March 2020.

Of participants involved in virtual visits, only one participated in in-person clinic visits; the other four residents were only involved in virtual outpatient visits during their elective. In terms of questions pertaining to virtual care, three of five reported commonly staffing

with the attending prior to the virtual visit, while two reported other (unspecified) methods of staffing. The educational value of virtual outpatient visits (rated as “not at all, slightly, moderately, very, or extremely useful”), was rated as “very useful” by two and “extremely,” “slightly,” or “moderately” useful by one respondent each (Fig. 1). Midpandemic trainees were asked, “Overall how do you feel your education while on the pediatric genetics elective was impacted as a result of the COVID-19 pandemic?” with possible answers of “very negatively,” “somewhat negatively,” “neither negatively or positively,” “somewhat positively,” and “very positively.” Two of five reported “somewhat positively,” 1 chose “very positively,” 1 chose “neither negatively or positively,” and 1 chose “somewhat negatively” (Fig. 1).

Overall, 22/23 rotators (96%) reported receiving in-person or virtual teaching during the elective. Nineteen felt the number of sessions was “just right,” one reported “too few” and two reported “too many.” Twelve reported teaching sessions as “very effective,” five as “extremely effective,” and five as “moderately effective.” Those who took the elective before the pandemic were asked how they would predict their education in varying domains would be impacted (Fig. 2a). Overall alternatively, those who took the elective during the pandemic were asked how they felt their education would have been different prepandemic (Fig. 2b). Trainees were additionally asked if they would recommend the elective to a coresident. Twenty-two of 23 responded “yes,” 1 “unsure,” and no trainees responded “no.”

Trainees were asked to assess their level of competency in various domains prior to the elective and then following the elective (Figs. 3 and 4). Both groups showed a self-assessed improvement in all domains. The only domain still assessed by a resident to be “Very poor” following the elective was “Genetic counseling” in a trainee taking the elective midpandemic. For prepandemic residents the average pre- and postelective competency scores for each domain were as follows (1 = Very poor and 5 = Very good): genetic syndromes pre 2.6 and post 3.4; biochemical genetics medical knowledge pre 2.2 and post 3.2; dysmorphology examination pre 2 and post 3.4; genetic counseling pre 2.1 and post 3.1; Family history collection pre 3.1 and post 4. For midpandemic residents the average pre and postelective competency scores for each domain were as follows (1 = Very poor and 5 = Very good): genetic syndromes pre 2.3 and post 3.2; biochemical genetics medical knowledge pre 2 and post 2.8; dysmorphology examination pre 1.8 and post 3.2; genetic counseling pre 1.8 and post 2.6; family history collection pre 2.8 and post 4.2.

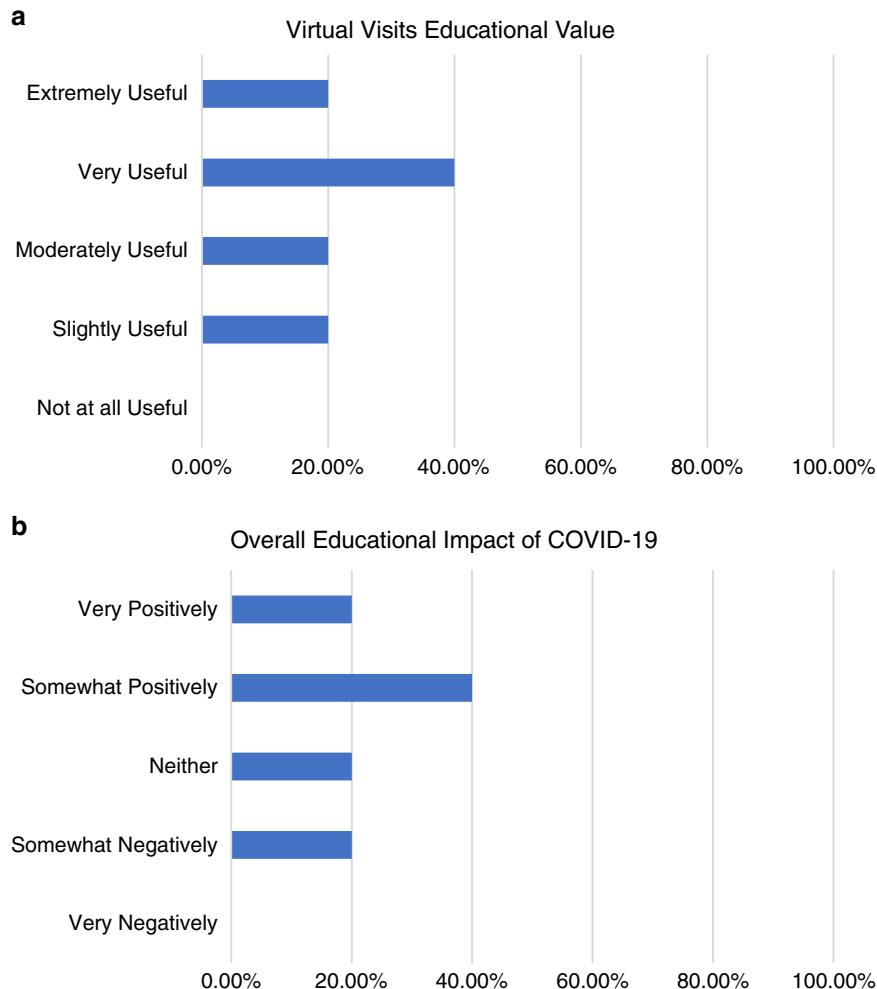
## DISCUSSION

This work assesses resident perspectives of training in medical genetics during the pandemic. Our results indicate strengths and weaknesses of education during the pandemic, and highlight some well-received methods for supplementing resident education. Overall, pediatric residents reported receiving useful educational sessions both pre- and midpandemic with improvements in self-assessed competency of many medical genetics domains. Trainees rotating during the pandemic reported involvement in virtual care and that these patient visits had utility in their education. Most pediatric residents who rotated before the pandemic indicated they would have expected “somewhat worse” or “much worse” education across most domains, especially dysmorphology and genetic counseling. Interestingly, those who rotated amidst the pandemic indicated they felt most of their education would have remained the same, with potential weak areas including dysmorphology and genetic counseling. Pediatric residents rotating midpandemic overall reported a neutral or positive impact of the pandemic on their elective rotation. Prior work has indicated that a medical genetics rotation is often highly useful to pediatric residents,<sup>8</sup> and responses in this survey indicate

**Table 1.** Demographics.

Year in residency	Number (%)
PGY-1	2 (9)
PGY-2	10 (43)
PGY-3	10 (43)
PGY-4	1 (5)
Length of rotation	
3 weeks	10 (43)
4 weeks	13 (57)
Participation in in-person clinics	
Yes	19 (83)
No	4 (17)
Clinics per week	Mean (range)
Prepandemic	1.8 (1–2.5)
Midpandemic	2 (1.6–2.5)
Clinic patients per week	Mean (range)
Prepandemic	3.1 (1.3–4.5)
Midpandemic	2.2 (1.3–3)
Participation in virtual visits	Number (%)
No	18 (78)
Yes	5 (22)

PGY postgraduate year.



**Fig. 1 Educational experiences of midpandemic trainees.** (a) Self-assessed educational value of the educational value of virtual visits. (b) Estimated overall educational impact of COVID-19 on education on the genetics elective.

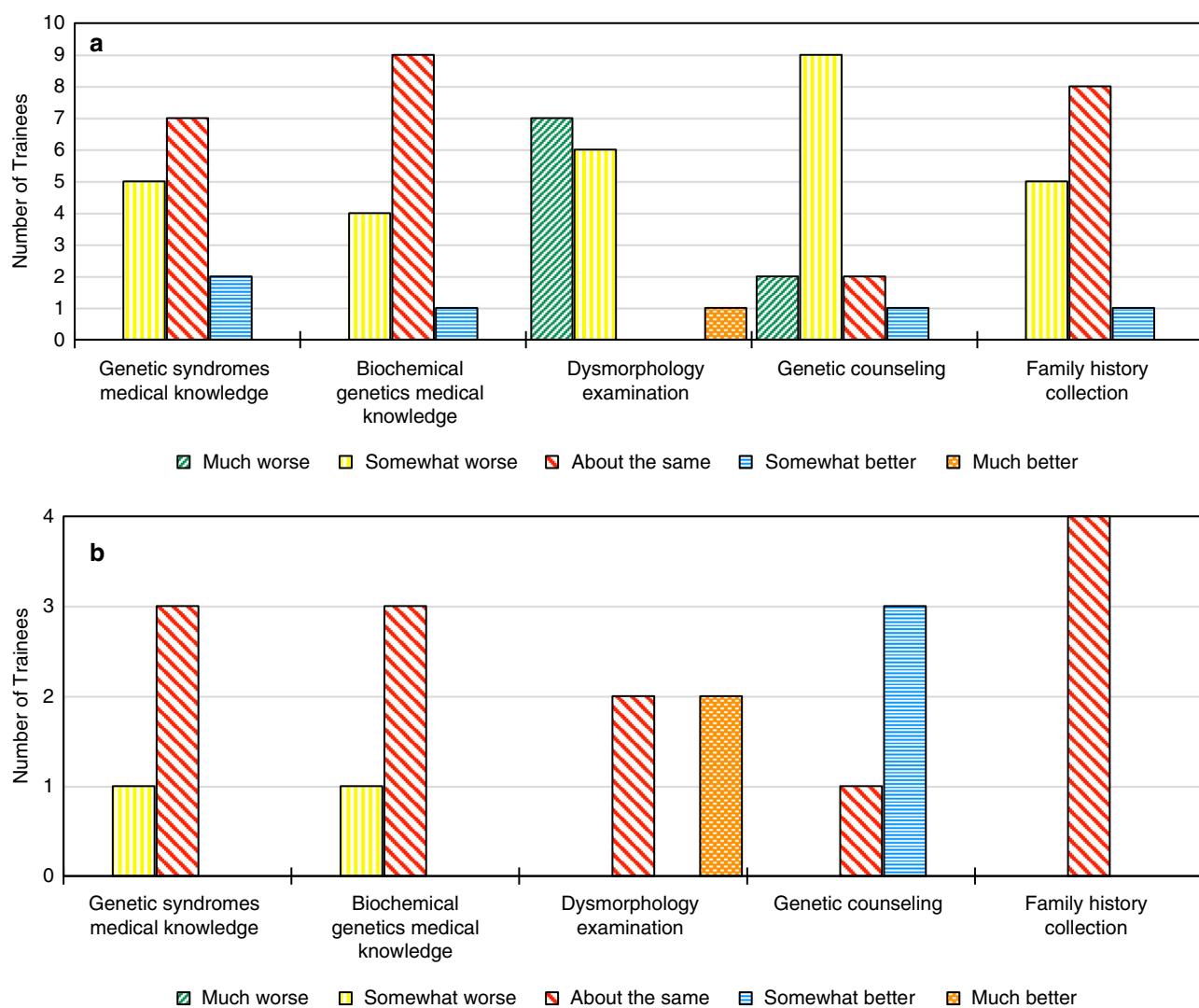
that pediatric residents can still deepen their knowledge of genetics in a primarily online or remote format.

Dysmorphology examinations are unavoidably different and limited when performed virtually, so our results from midpandemic rotating residents' expectations is not surprising. Importantly, all residents rotating midpandemic reported an improved ability to perform a dysmorphology examination following the elective. It should be noted though that residents on the elective were still participating in inpatient consultations so these data do not show the utility of dysmorphology education in a completely virtual environment. However, it does indicate a need to grow and improve our virtual dysmorphology educational curriculum. The education of a comprehensive dysmorphology exam has already been noted to be negatively affected by the more recent genotype-first paradigm of a genetics evaluation.<sup>9</sup> Dysmorphology examinations have been successfully incorporated into a telegenetics program in Maine with best practices for these examinations and their education necessary going forward.<sup>10</sup> Facial recognition artificial intelligence software is a potential solution to address the barriers to an effective virtual dysmorphology examination, though how positively or negatively this software impacts education has yet to be determined.<sup>11</sup>

We also noted trainees rotating midpandemic did not report concerns regarding knowledge base or family history collection, perhaps a testament to the utility of virtual didactic sessions and ample opportunities for observation and practice of family history-taking skills. We found the incorporation of a virtual

curriculum incredibly useful both as an educational strategy but additionally to increase communication with rotating residents during their elective. This communication benefit is especially important to note given the isolation trainees have noted as a result of social distancing requirements and their potentially negative impacts on wellness.<sup>4</sup>

We additionally identified training in genetic counseling may have been impacted with midpandemic rotating residents still noting low self-assessed competency in this domain following the elective. Virtual care allows for visualization of the patient and family but may limit recognition of more subtle social cues that can guide counseling. While virtual genetic counseling has been shown to be as good as in-person genetic counseling, most previous work focused on counseling in cancer or prenatal genetics.<sup>12</sup> Further research would be helpful to elicit which aspects of education in counseling are most impacted by virtual visits as data on this topic have not yet been reported. Data are likely to be forthcoming on this topic in the near future given the modifications of genetic counseling training programs required postpandemic. As an example of this, at Michigan Medicine the genetic counseling training program has continued to utilize virtual visits for rotating trainees on the pediatrics elective given social distancing-required space limitations in clinic and exam rooms. The limited genetic counseling education may additionally have been the result of fewer genetic counseling virtual visits scheduled at the beginning of the pandemic with these visits preferentially rescheduled to a future date given most are not deemed urgent by patients and families.



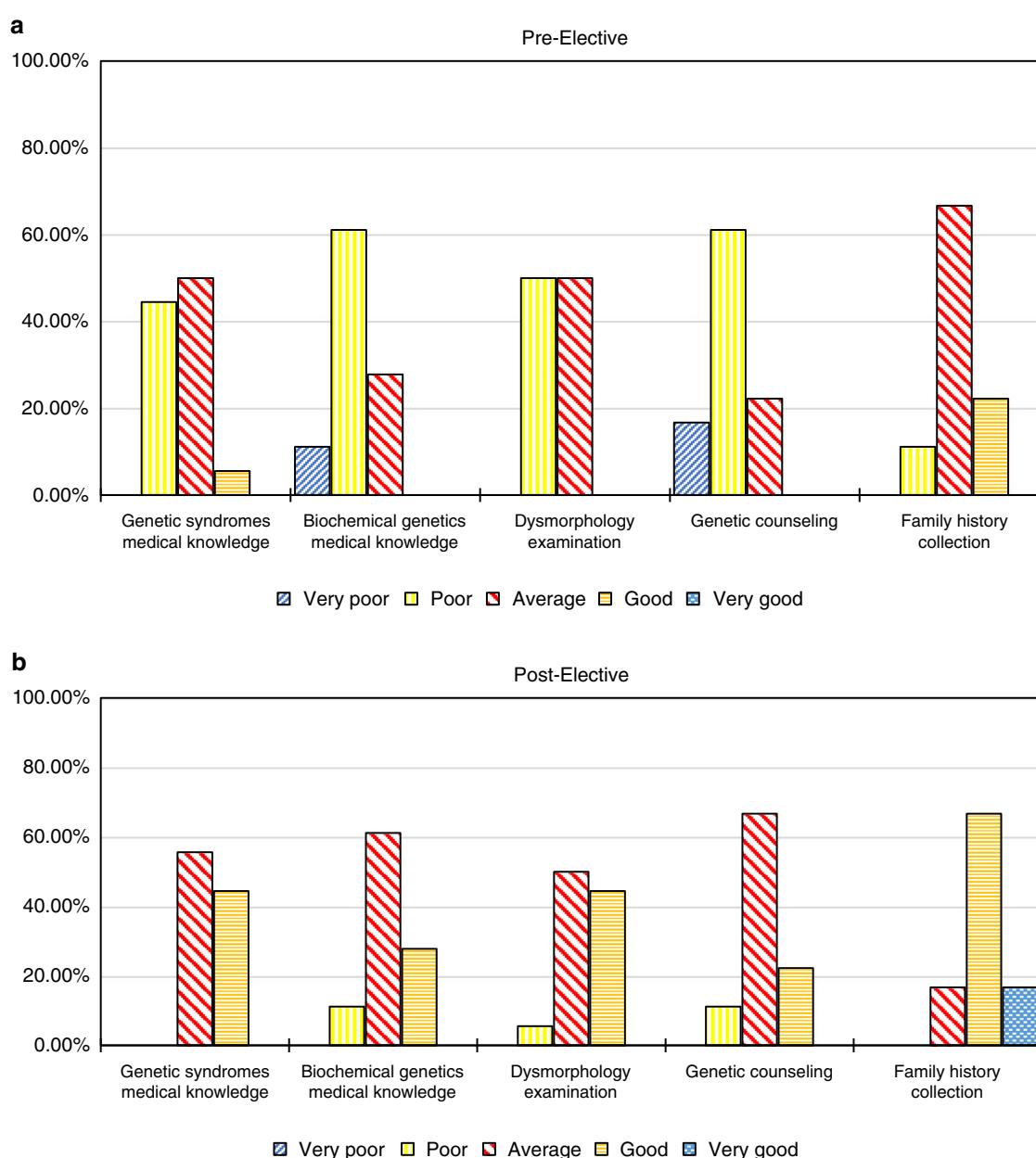
**Fig. 2 Predicted impact of pandemic on educational experience for pre- and midpandemic residents.** (a) Predicted impact of pandemic on education by prepanademic residents (14 respondents). (b) Predicted educational experience of midpandemic residents if elective had occurred prepanademic (4 respondents).

Faculty have inevitably had to rapidly adjust teaching strategies both within and outside of clinic. The educational curriculum, primarily consisting of sessions conducted through Zoom, was well-received. Current generations of learners may actually prefer online learning methods to the traditional in-person classroom lecture,<sup>13</sup> so establishing a virtual education model may have long-term utility past the current health crisis. The educational curriculum also involved lectures from molecular and biochemical laboratory faculty, as the in-person experience in these locations was lost. Further research may help elucidate best practices in continuing educational laboratory experiences in a remote or virtual format. This work will be especially important for genetics trainees as their hands-on laboratory education has a more significant impact on their genetics education compared with rotating pediatrics residents.

Staffing in our cohort was noted to most frequently utilize a preclinic staffing model. This typically involved the faculty and trainee reviewing the case in advance by telephone or Zoom, discussing the differential, reviewing important history questions, and speaking about possible testing strategies. Advantages to this method include limiting patient waiting time in a virtual “waiting room” and avoiding potential disruptions due to technology issues. Trainees were overall receptive of this method. In survey comments one noted, “I really think the pre-staffing model was so helpful and

educational. I really don’t think my education on this elective was negatively impacted at all because of the changes made by COVID-19.” Disadvantages to pre-staffing include additional time needed on the part of faculty in advance of the clinic, and that in certain cases if the information in the medical record is sparse it may be difficult to anticipate the plan.

There are several limitations to this research, including that the data is self-reported by trainees. Bias is possible in terms of remembering details of the rotation, and there is possible bias in which individuals chose to respond to the survey. Many prepanademic rotators had completed their pediatric genetics rotation months (up to one year) before completing the survey, which may have resulted in limited recall of the experience. Though this limitation exists we intentionally surveyed only trainees still in residency to avoid further recall issues with changing practice settings. In addition, the limited number of trainees able to respond to questions regarding education during the pandemic makes it difficult to generalize these results broadly though the work is strengthened by a high response rate. We also noted differences in the number of patients residents saw over the course of their elective pre- and midpandemic, although no difference in the number of clinics was noted. The real world significance of this difference is likely minimal though given both

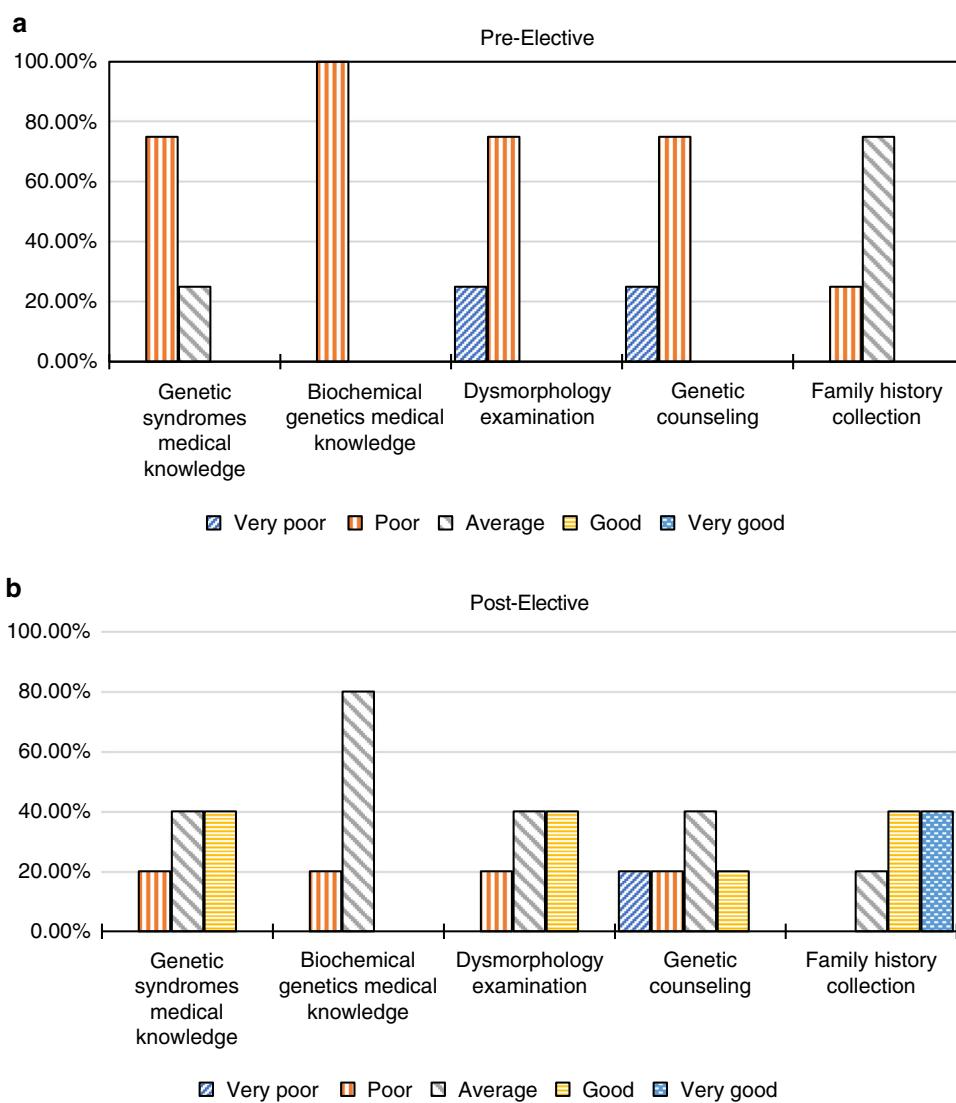


**Fig. 3 Self-assessed competency pre- and post-elective for rotators midpandemic.** Rotators completing the elective prepandemic ( $n = 18$ ) reported self-assessed competency before the elective (a) and after the elective (b) in multiple domains.

groups saw between one and two patients per clinic session. While the self-assessed competency data showed improvement in all domains assessed, we did not have additional input from faculty or standardized evaluations to confirm these improvements. Self-assessed competency can vary by level of training and residency program type, although some literature has shown concordance between self-assessed competency and assessment by clinical competency committees.<sup>14</sup> Furthermore, given how rapidly clinical practice and education changed following the onset of the pandemic best practices for virtual care and virtual education had not been established for our division. We anticipate with time there will be further improvements in virtual care delivery and educational practices as experience with these platforms increases. Going forward it will be important to continue to address trainee satisfaction and experiences with medical genetics education especially considering the ongoing uncertainty of the future impacts of the COVID-19 pandemic. Importantly, the

data presented here do not directly address genetics trainees. Given most programs have a relatively small number of genetics trainees, future work in this area should assess genetics trainee perspectives across multiple programs.

At our institution, the number of in-person clinical experiences has increased over the past few months allowing for the reincorporation of trainees into more nonvirtual clinical experiences. Given the potential for future restrictions based on the trajectory of the virus worldwide we recommend those involved in medical genetics education consider how best to educate trainees using nontraditional experiences. Based on our experiences we propose the following practices be considered to provide optimal educational experiences: creation of a livestreamed virtual didactic series, utilization of a pre-staffing virtual clinic model, supplementary dysmorphology education, optimization of virtual teaching methods, and close collaboration with genetic counselors to optimize genetic counseling exposure and education.



**Fig. 4 Self-assessed competency pre- and post-elective for rotators midpandemic.** Rotators completing the elective midpandemic reported self-assessed competency before the elective (**a**; 4 respondents) and after the elective (**b**; 5 respondents) in multiple domains.

While this work gives us a limited understanding of the impact of the COVID-19 pandemic on education in genetics, it indicates that trainees do see a role of virtual visits in education and that virtual education efforts are of the utmost importance. Given the paucity of genetics providers, it is crucial that we continue our efforts in education of both genetics and nongenetics trainees during this tumultuous time.

## DATA AVAILABILITY

Data presented here are available upon request.

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## AUTHOR CONTRIBUTIONS

Conceptualization: S.C.Q., A.B.P. Data curation: S.C.Q., A.B.P., C.S.-H. Formal analysis: A.B.P., C.S.-H. Investigation: S.C.Q., A.B.P., C.E.K., C.S.-H. Methodology: S.C.Q., A.B.P.

Project administration: S.C.Q. Resources: S.C.Q. Software: S.C.Q. Supervision: S.C.Q. Visualization: S.C.Q., A.B.P., C.S.-H. Writing—original draft: A.B.P. Writing—review & editing: S.C.Q., C.E.K., C.S.-H.

## ETHICS DECLARATION

This research was determined to be exempt by the University of Michigan Institutional Review Board.

## COMPETING INTERESTS

The authors declare no competing interests.

## ADDITIONAL INFORMATION

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