Mapping the Clinical Experience of a New York City Residency Program During the COVID-19 Pandemic

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The COVID-19 pandemic has dramatically disrupted the educational experience of medical trainees. However, a detailed characterization of exactly how trainees' clinical experiences have been affected is lacking. Here, we profile residents' inpatient clinical experiences across the four training hospitals of NYU's Internal Medicine Residency Program during the pandemic's first wave. We mined *ICD-10* principal diagnosis codes attributed to residents from February 1, 2020, to May 31, 2020. We translated these codes into discrete medical content areas using a newly developed "crosswalk tool." Residents' clinical exposure was enriched in infectious diseases (ID) and cardiovascular disease content at baseline. During the pandemic's surge, ID became the dominant content area. Exposure to other content was dramatically reduced, with clinical diversity repopulating only toward the end of the study period. Such characterization can be leveraged to provide effective practice habits feedback, guide didactic and self-directed learning, and potentially predict competency-based outcomes for trainees in the COVID era. *Journal of Hospital Medicine* 2021;16:353-356. © 2021 Society of Hospital Medicine

The COVID-19 pandemic has disrupted the educational experience of medical trainees around the world, and this has been especially true for those in New York City (NYC), the early epicenter of the global outbreak.[1] The pandemic's surge required redeployment of trainees away from scheduled rotations, focused didactics around emerging COVID-19 data, and seemingly narrowed trainees' clinical exposure to a single respiratory infection.

While there is a small body of literature describing the programmatic responses[2,3] and educational adaptations[4-7] that have come about as a result of the pandemic's disruptive force, a characterization of exactly how trainees' clinical experiences have been affected is lacking. A detailed understanding of how trainees' inpatient care activities evolved during the pandemic could provide valuable practice habits feedback, allow for comparisons across training sites, focus content selection for didactic learning and self-study, and potentially help forecast similar clinical changes in the event of a subsequent wave. Perhaps most important, as internal medicine (IM) trainees require broad exposure to diverse clinical conditions to mature toward independent practice, a characterization of exactly how the pandemic has narrowed the diversity of clinical exposure could inform changes in how trainees attain clinical competence.

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Profiling IM residents' clinical experiences in a meaningful way is particularly challenging given the extraordinary breadth of the field. We recently developed a strategy by which resident-attributed *International Classification of Diseases, Tenth Revision* (*ICD-10*) principal diagnosis codes are mapped to an educational taxonomy of medical content categories, yielding clinical exposure profiles.[8] Here, we apply this mapping strategy to all four training hospitals of a large NYC IM residency program to catalogue the evolution of clinical diversity experienced by residents during the COVID-19 pandemic.

METHODS

Study Population

The NYU IM Residency Program comprises 225 resident physicians rotating at four inpatient training sites: NYU Langone Hospital–Brooklyn (NYU-BK), NYU Langone Hospitals–Manhattan (NYU-MN), Bellevue Hospital (BH), and VA–New York Harbor Healthcare (VA). The study period was defined as February 1, 2020, to May 31, 2020, to capture clinical exposure during baseline, surge, and immediate post-surge periods. The NYU IM residency program declared pandemic emergency status on March 23, 2020, after which all residents were assigned to inpatient acute care and intensive care rotations to augment the inpatient workforce.

Data Source

Clinical data at each training hospital are collected and stored, allowing for asynchronous querying. Given differences in data reporting, strategies for collecting principal *ICD-10* codes of patients discharged during the study period differed slightly across sites. Principal *ICD-10* codes from patients discharged

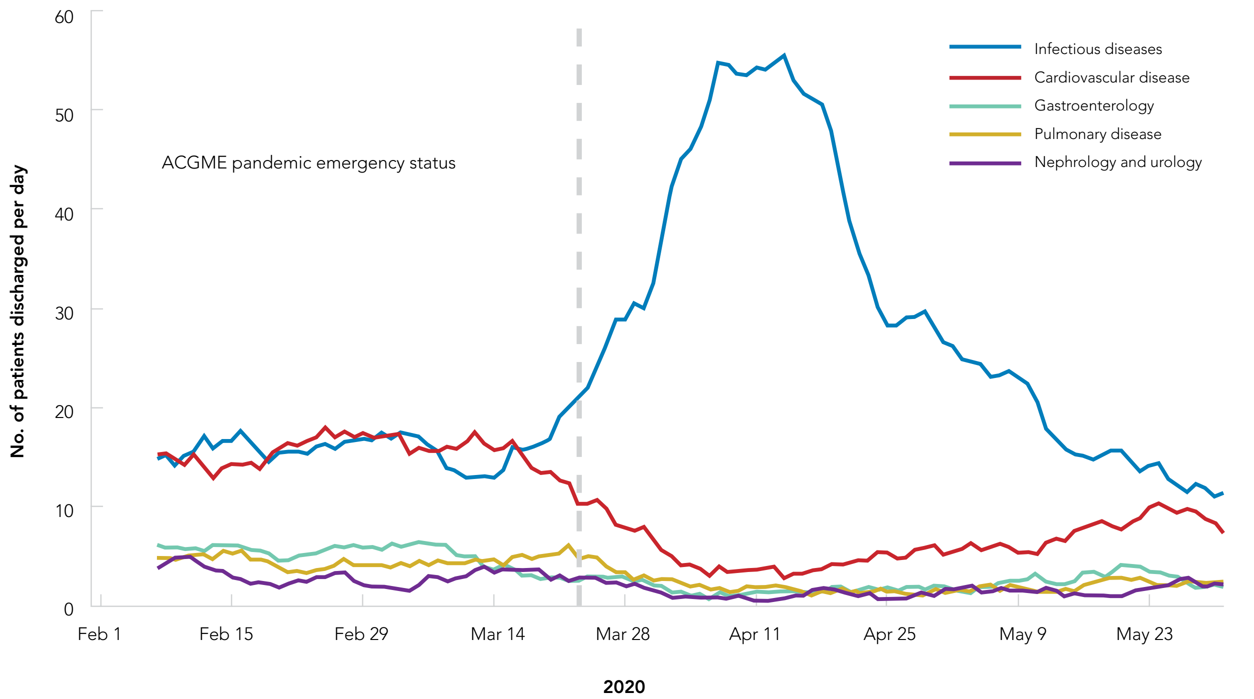

FIG. Frequencies of the Top 5 ABIM Content Areas Encountered by Residents in the NYU Internal Medicine Residency Program's Four Training Sites (February 1, 2020-May 31, 2020). The graph shows the running 7-day average of the number of daily discharges in the top ABIM content areas.

from NYU-BK and NYU-MN were filtered by nursing unit, allowing selection for resident-staffed units. Principal *ICD-10* codes from BH were curated by care team, allowing selection for resident-staffed teams. Principal *ICD-10* codes from VA were filtered by both hospital unit and provider service to attribute to resident providers. Dates of each discharge were included, and mortalities were included as discharges. All methods yielded a dataset of principal *ICD-10* discharge diagnosis codes attributed primarily to IM residents. Given the rapid changes in hospital staffing to care for increasing patient volumes, in rare circumstances residents and other providers (such as advanced practice providers) shared hospital units. While *ICD-10* codes mined from each hospital are attributed primarily to residents, this attribution is not entirely exclusive. Data were analyzed both by training site and in aggregate across the four training sites. No individually identifiable data were analyzed, the primary goal of the project was to improve education, and the data were collected as part of a required aspect of training; as a result, this project met criteria for certification as a quality improvement, and not a human subject, research project.

The Crosswalk Tool

We previously developed a crosswalk tool containing 4,854 *ICD-10* diagnoses uniquely mapped to 16 broad medical content areas as defined by the American Board of Internal Medicine (ABIM).[8] Custom programs (MATLAB, MathWorks, Inc) captured and subsequently mapped resident-attributed *ICD-10* discharge codes to content areas if the syntax of the *ICD-10* code in question exactly matched or was nested within an *ICD-10* code in the crosswalk. This tool allowed us to measure the daily discharge frequency of each content area across the sites.

Analysis

The sensitivity of the crosswalk tool was calculated as the number of *ICD-10* codes captured divided by the total number of patients. Codes missed by the tool were excluded. The total number, as well as the 7-day running average of discharges per content area, across the sites during the study period were measured. To evaluate for differences in the distribution of content before and after pandemic emergency status, 2×16 χ^2 contingency tables were constructed. To evaluate for changes in the mean relative proportions (%) of each content area, paired *t* tests were conducted. Confidence intervals were estimated from *t* distributions.

RESULTS

There were 6,613 patients discharged from all sites (NYU-BK, 2,062; NYU-MN, 2,188; BH, 1,711; VA, 652; Appendix Table). The crosswalk tool captured 6,384 principal discharge *ICD-10* codes (96.5%). The five most common content areas during the study period were infectious diseases (ID; n = 2,892), cardiovascular disease (CVD; n = 1,199), gastroenterology (n = 406), pulmonary disease (n = 372), and nephrology and urology (n = 252).

These were also the content areas most frequently encountered by residents at baseline (Figure and Table). The distribution of content prior to declaration of pandemic emergency status was significantly different than that after declaration (χ^2 = 709; *df*, 15; *P* <.001). ID diagnoses, driven by COVID-19, rose steeply in the period following declaration, peaked in mid-April, and slowly waned in May (Figure). The mean relative percentage of ID discharges across the sites rose from 26.0% (16.5%-35.4%) at baseline to 58.3% (41.3%-75.3%) in the period after pandemic emergency status was declared (*P* = .005).

Frequencies of diagnoses mapping to other content areas decreased significantly, reflecting a marked tapering of clinical diversity (Figure and Table). Specifically, decreases were seen in CVD (27.6% [95% CI, 17.9%-37.2%] to 13.9% [95% CI, 5.5%-22.3%]; *P* = .013); gastroenterology (8.3% [95% CI, 6.2%-10.2%] to 4.6% [95% CI, 2.1%-6.9%]; *P* = .038); pulmonary disease (8.0% [95% CI, 5.6%-10.2%] to 4.6% [95% CI, 1.6%-7.4%]; *P* = .040); and nephrology and urology (4.8% [95% CI, 2.6%-6.9%] to 3.1% [95% CI, 1.9%-4.2%]; *P* = .047) (Table). In late April, diagnoses mapping to these content areas began to repopulate residents' clinical experiences and by the end of the study period had nearly returned to baseline frequencies. These patterns were similar when discharge diagnoses from each training site were plotted individually (Appendix Figure).

TABLE. **Mean Relative Proportion of Discharges in Each Content Area Across the Four Sites Before and After the Pandemic Emergency Status**

	Mean total discharges (95% CI), %		
	Before emergency status	After emergency status	*P* value[a]
Infectious diseases	26.0 (16.5-35.4)	58.3 (41.3-75.3)	.005
Cardiovascular disease	27.6 (17.9-37.2)	13.9 (5.5-22.3)	.013
Gastroenterology	8.3 (6.2-10.2)	4.6 (2.1-6.9)	.038
Pulmonary disease	8.0 (5.6-10.2)	4.6 (1.6-7.4)	.040
Nephrology and urology	4.8 (2.6-6.9)	3.1 (1.9-4.2)	.047
Endocrinology diabetes and metabolism	4.5 (1.5-7.4)	2.7 (0.9-4.3)	.121
Psychiatry	4.8 (1.6-7.8)	3.3 (1.3-5.2)	.054
Neurology	5.0 (2.0-8.0)	2.8 (0.6-4.9)	.004
Hematology	4.1 (1.3-6.9)	2.3 (1.7-2.8)	.140
Medical oncology	2.8 (0-6.0)	1.5 (0.3-2.6)	.180
Rheumatology and orthopedics	2.4 (1.8-2.8)	1.5 (0.6-2.2)	.066
Obstetrics and gynecology	0.4 (0.0-0.9)	0.5 (0.1-0.9)	.120
Otolaryngology and dental medicine	0.5 (0-0.9)	0.4 (0.09-0.6)	.720
Dermatology	0.4 (0.06-0.7)	0.3 (0.1-0.4)	.319
Allergy and immunology	0.4 (0-1.4)	0.2 (0-0.6)	.634
Ophthalmology	0.1 (0-0.3)	0.1 (0-0.3)	.955

[a] *P* values reflect paired *t*-test results.

DISCUSSION

Here, we demonstrate how the clinical educational landscape changed for our residents during the COVID-19 pandemic. We uncover a dramatic deviation in the content to which residents were exposed through patient care activities that disproportionately favored ID at the expense of all other content. We demonstrate that this reduction in clinical diversity persisted for nearly 2 months and was similar at each of our training hospitals, and also provide a trajectory on which other content repopulated residents' clinical experiences.

These data have served several valuable purposes and support ongoing efforts to map residents' experiential curriculum at our program and others. Sharing this data with residents, as occurred routinely in town hall forums and noon conferences, has provided them with real-time practice feedback during a time of crisis. This has provided scope for their herculean efforts during the pandemic, served as a blueprint for underrepresented content most ripe for self-study, and offered reassurance of a return to normalcy given the trajectory of clinical content curves. As practice habits feedback is an Accreditation Council for Graduate Medical Education requirement, this strategy has also served as a robust and reproducible means of complying.

Our training program used this characterization of clinical content to help guide teaching in the pandemic era. For example, we preferentially structured case conferences and other didactics around reemerging content areas to capitalize on just-in-time education and harness residents' eagerness for a respite from COVID-specific education. Residents required to quarantine at home were provided with learning plans centered on content underrepresented in clinical practice.

Given the critical importance of experiential learning in IM residents' training, our findings quantifying significant changes in clinical exposure could form the basis for predicting poor outcomes in competency-based assessments for residents training in the COVID era, which continues to affect our trainees. For example, our characterization of clinical exposure may predict poor in-training exam or even ABIM certification exam performance in the content areas most drastically affected. Knowledge of this association of clinical exposure and clinical competence could allow training programs like ours to preempt poor performance in competency-based assessments by more aggressively shifting lectures, simulations, and other didactic programs toward content areas underrepresented in the pandemic's wake.

Limitations of this study include the fact that availability of testing and *ICD-10* coding for COVID-19 differed slightly across training sites, potentially contributing to site differences in mapping. Additionally, given our 1:1 mapping of *ICD-10* codes to content categories, our strategy attributes COVID-19 to ID alone, and does not capture additional areas germane to this diagnosis, such as pulmonary disease.

CONCLUSION

We provide a detailed characterization of the evolution of a single IM program's patient care experiences across four training hospitals during the COVID-19 pandemic. Such characterization can be leveraged to provide effective practice habits feedback and guide teaching efforts, and could form the basis to predict competency-based outcomes for trainees in the COVID era.

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