



# Improving Equitable Access to Imaging: Developing an On-Site Ultrasound Service at a Student-Run Free Clinic

Nicholas C Neel<sup>1</sup>; Aislinn McMillan<sup>1</sup>; Lee Hsieh<sup>1</sup>; Jimmy Bazy, MD<sup>1</sup>; Anthony Tadros, MD<sup>2</sup>; Dorothy Tamayo-Murillo, MD<sup>2</sup>

<sup>1</sup>University of California San Diego School of Medicine, La Jolla, California, USA

<sup>2</sup>Department of Radiology, University of California San Diego School of Medicine, San Diego, California, USA

**Corresponding Author:** Dorothy Tamayo-Murillo; email: dtamayomurillo@health.ucsd.edu

**Published:** December 20, 2022

## Abstract

**Background:** Student-run free clinics (SRFC) provide comprehensive primary care for uninsured populations throughout the country. However, imaging remains a barrier to care for underserved communities that experience inequitable access to healthcare. In this study, we describe the establishment of a radiology specialty clinic (RSC) that served as an in-house ultrasound imaging service at our institution's SRFC.

**Methods:** Between September 2019 and March 2020, patients were scheduled for imaging at the free clinic site, and studies were performed and read by institutional radiologists. Patient data were reviewed to assess patient demographics, study indication, ultrasound type, and time between referral and appointment. Lastly, imaging utilization was examined seven months prior to and seven months after implementing the free ultrasound clinic to assess any changes in usage, wait time, or referral patterns using Fischer's exact test and unpaired student t-tests.

**Results:** A total of 10 patients were seen during the clinic's operation, with 11 studies being performed. Overall, usage patterns stayed consistent pre and post-implementation. There was no significant difference in wait times between referral and appointment (pre-RSC 15 days vs. post-RSC 18.5 days,  $p=0.91$ ) and the RSC demonstrated a total cost savings of \$770 to the clinic.

**Conclusions:** We describe the implementation of an in-house ultrasound imaging service at our SRFC. The RSC provided increased access to imaging, demonstrated cost-savings to the SRFC, and had no negative effects on ultrasound usage or wait times between referrals and appointments.

## Introduction

Diagnostic imaging is one of the foundations of excellent patient care as its use traverses the spectrum of healthcare. Imaging plays a role in informing diagnoses, surveilling disease progression, and screening prevention. While its use is robust in specific populations, it is often underutilized by medically underserved and marginalized communities due to inaccessibility or prohibitive cost, leading to delayed diagnoses or poor disease monitoring.<sup>1-6</sup> With the aid of multidisciplinary teams, radiologists can work to bridge these gaps in healthcare by providing needed health services to those requiring necessary imaging.<sup>7</sup>

Student-run free clinics (SRFCs) have become

a staple of medical education. They provide free care to under or uninsured patients while creating a teaching opportunity for medical students.<sup>8,9</sup> However, despite receiving free care, many patients still face challenges in obtaining outside resources, such as necessary imaging, in a timely manner due to imaging services being outsourced to other facilities. These studies often come at a price to the already underfunded clinics and place additional burdens on patients faced with limited transportation and little time to take off work for healthcare needs. Lastly, these images do not easily transfer into the patients' electronic healthcare records unless they are manually uploaded by support staff, making it difficult for the primary care provider to review

images independently.

Ultrasonography has been recognized as a cost-effective standard-of-care imaging modality that has successfully been implemented to provide imaging services to underserved communities, both nationally and internationally. It has become a standard across many aspects of medical care and there has been increasing interest in its expansion into underserved medicine.<sup>10</sup> Others have shown point-of-care ultrasound (PoC-US) to be effective in many under-resourced settings with respect to quality and timeliness of diagnosis and medical student education, with incorporation into SRFCs.<sup>11-14</sup> However, these studies all revolve around PoC-US. To our knowledge, no studies to date have investigated the integration of complete sonographic studies at free clinics. Full diagnostic protocol studies allow providers to follow-up on imaging within imaging databases and allow reports to be available to all providers. Moreover, this provides a standardized method of image acquisition by certified sonographers and allows radiologists to read the studies remotely, providing the same standard of care as sonographic studies performed in-house through the radiology department.

These ideas led to the integration of a Radiology Specialty Clinic (RSC) into a SRFC at the University of California, San Diego School of Medicine, which provides comprehensive medical care to San Diego County's uninsured residents.<sup>8</sup> In 2019, the RSC was established as an in-house imaging service that functions as an outpatient ultrasound imaging suite.<sup>15</sup> Patients were referred to the RSC for studies by the patient's primary care team through the free clinic's internal referral system. Patients were then scheduled to attend a monthly clinic session at one of our institution's SRFC sites to have imaging performed. The clinic consisted of volunteer faculty, sonographers, residents, and medical students who would perform complete ultrasound studies, including abdominal, superficial soft tissue, and deep vein thrombosis (DVT) studies. Pelvic and transvaginal imaging is currently not offered due to a lack of equipment. These studies would then be sent to our institutional radiologists to read and subsequently uploaded into the patient's chart. Once completed, study images and reports would be available for the patient and their

provider to review. The RSC began in September 2019 and held one clinic per month during its seven-month pilot period until March 2020, prior to county-mandated cessation during the coronavirus disease 2019 (COVID-19) pandemic. This paper examines the ultrasound usage patterns and associated patient demographic data from the first seven months of the RSC. These data were then compared to the previous seven months of SRFC imaging usage prior to implementation of the RSC to assess differences in the time from referral to the appointment, studies obtained, and associated costs of outside imaging.

## Methods

This was a retrospective review of all patients who received care at the RSC between September 2019 and March 2020. Institutional Review Board exemption was received as this study was designated quality improvement status. Study data were obtained from a student-designated Microsoft Access (2021, Microsoft, Redmond, WA) clinical database. Outside records and paper charts were consulted when necessary. Quantitative data from the study period were computed and included the total number of referrals, total number of patients seen, total attendance of patients to clinical sessions, average time between referral and clinic appointment, and patient demographics. Qualitative measures included the type of study requested and the indications for the request. Patients who received outside ultrasound imaging from the SRFC between February 2019 to August 2019 were examined to assess differences in referral patterns, time from referral to the appointment, and studies obtained before and after RSC implementation. A total of 24 ultrasound studies were performed during the pre-RSC period. Six of those studies were pelvic or transvaginal studies which were not included in the analysis due to the inability of the RSC to offer these services, leaving a total of 18 studies. One patient had two ultrasound studies performed and one patient's information could not be obtained and was excluded from analysis. In total, 17 studies were performed on 16 different patients. Fischer's exact test and unpaired student t-tests were used to analyze differences in categorical

**Table 1.** Implementation of the radiology-specialty clinic (RSC).

Characteristics	Pre-RSC % (n=16)	Post-RSC % (n=10)	p-value
Mean age, years (SD)	49.8 (11.4)	56.2 (8.9)	0.14
Gender			
Female	88	80	0.62
Male	12	20	
Ethnicity			
Hispanic	94	100	0.99
Non-Hispanic	6	0	
Primary language			
Spanish	75	100	0.25
English	19	0	
Haitian Creole	6	0	
Median household income, \$ (SD)	47,322 (12,212)	51,363 (13,209)	0.58
Insurance			
None	63	40	0.42
Medicaid	37	60	

Patient demographics remained largely unchanged with most patients being Spanish-speaking females.

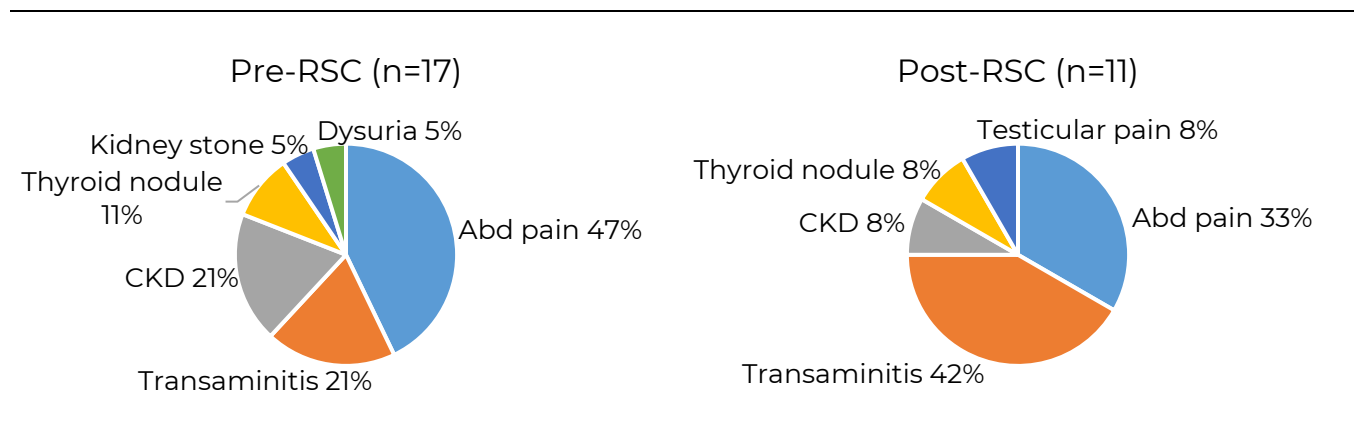
RSC: Radiology Specialty Clinic; SD: standard deviation

and continuous variables, respectively, using Microsoft Excel (Version 16.64, Microsoft, Redmond, WA).

## Results

In total, ten patients were seen at the RSC between September 2019 to March 2020. Additionally, one patient received two studies, resulting in eleven total ultrasound studies. This compares with seventeen patients and studies in the prior seven months. Compared to pre-RSC implementation, patient demographics remained essentially unchanged, with a majority being Hispanic, female, and Spanish-speaking, with no significant difference in insurance coverage (Table 1). Indications for ultrasound imaging remained similar, with abdominal pain and transaminitis being the most common. Testicular pain was the only new indication compared to pre-RSC implementation (Figure 1). Ultrasound study type remained similar as well with complete abdominal ultrasound being the most performed study (35% pre-RSC to 45% post-RSC), followed by right upper quadrant (35% to 18%), kidney and neck ultrasound (17% to 9%) and lastly scrotal and bladder studies being added post-RSC (Figure 2). Wait times also did not change significantly post-RSC implementation as compared to pre-RSC, including the median wait time between referral and appointment (pre-RSC 15 days, post-RSC 18.5 days, p=0.91). Lastly, utilization of the RSC saved the free clinic \$770 since each study would cost the clinic \$70 in out-of-pocket expenses. The SRFC orders roughly 40 ultrasound studies per

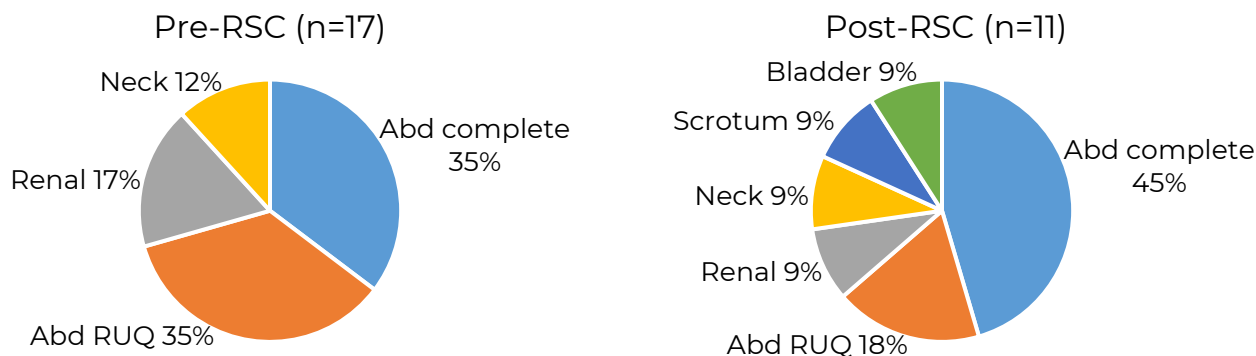
**Figure 1.** Indications for ultrasound imaging pre-RSC implementation (n=17) and post-RSC implementation (n=11).



Indications remained similar prior to, and after, RSC implementation.

RSC: Radiology Specialty Clinic; Abd: abdominal; CKD: chronic kidney disease

**Figure 2.** Percentage of ultrasound studies (categorized by type) performed before (n=17) and after implementation of the radiology specific clinic (n=11).



RSC: Radiology Specialty Clinic; Abd: abdominal; RUQ: right upper quadrant

year, leading to potential cost savings of roughly \$2,800 (40 ultrasounds at \$70/study) for the clinic annually.

### Discussion

We describe, to the best of our knowledge, the development of the first in-house imaging service to provide free complete ultrasonographic studies to underinsured patients at a SRFC. We performed ultrasounds for ten patients in the first seven months of operation, completing eleven full imaging studies. We observed no difference in usage patterns or wait times and demonstrated cost savings with the development of an ultrasound-incorporated imaging suite at the free clinic. These data provide evidence of the utility to incorporate a stand-alone ultrasound clinic into a SRFC.

While incorporating an in-house imaging service for our SRFC greatly improved access to imaging, there were concerns with increased wait time due to limited clinics, changes in referral patterns, and inappropriate usage or overutilization. Rising rates of imaging can inflate healthcare costs, create undue stress for patients, and further limit access to imaging services in resource-limited settings.<sup>16-18</sup> Despite these concerns, improper usage did not increase. There was a slight decrease in the number of imaging studies performed over a seven-month period after RSC implementation (17 to 11). However, this may be confounded by the COVID-19 pandemic, which forced the shutdown of in-person clinics and halted further ultrasound clinics after March

2020. In addition, some providers were unaware of the ultrasound clinic and continued to refer patients to outside facilities. During the months of the RSC operation, a total of six patients obtained outside ultrasound imaging that could have been performed at the RSC. This brings the total number of ultrasounds during this period to seventeen. Lastly, due to the novelty of the clinic, we started with fewer studies in the beginning (one patient per session) and slowly increased to 2-3 per session. If given the space to continue to develop, we hypothesize that the clinic could provide the same, if not more, imaging studies as previously seen in the clinic.

Overall, indication and utilization patterns remained steady. Abdominal pain and transaminitis remained the most common indications for studies, followed by chronic kidney disease and thyroid nodules, while testicular pain became a new indication for ultrasound studies. These indications represent chronic diseases our mainly underserved patient population face and require adequate surveillance.

Lastly, we saw no significant change in wait times. Given the RSC's limited infrastructure and team size, there was concern that having patients utilize the in-house service would increase wait times since ultrasound clinics were only held once per month. However, the median time between referral and actual appointment remained relatively stable at 15 days pre-RSC and 18 days post-RSC, indicating that utilization of the RSC does not negatively impact time from referral to imaging appointment. In fact, we may see a

decrease in wait times in the future since imaging can be provided at their usual primary care office (SRFC) without patients having to travel to outside facilities. Since many of our patients may not have personal transportation or jobs that permit time off to obtain additional medical care, such as imaging, the combination of an in-house imaging suite may shorten the time and burden faced by patients obtaining ultrasound studies.

This study has several limitations. First, our small sample size (mainly due to COVID-19) does not allow us to draw robust conclusions about trends in ultrasound usage in the free clinic. With additional time, we hope to examine these effects better. In addition, this is the experience of one academic center that has a well-established SRFC with electronic medical record capabilities, a donated ultrasound machine available for use, and volunteer radiology faculty and sonographers committed to helping the RSC succeed. The lack of these necessary tools or personnel may prevent its translation into other settings. However, this does provide proof-of-concept to the idea and promise of further expansion of a radiology service in a free clinic setting.

Overall, we describe the development of an in-house imaging ultrasound clinic at an SRFC that can save the clinic thousands of dollars annually. Additionally, we show that our RSC did not increase or cause improper usage, with no significant change in wait time from referral to appointment. Taken together, we show the feasibility of developing an RSC and its potential benefit for patient care in serving medically underserved populations without increasing costs or improper imaging usage. It is our hope that our experience can lead to further adoption of radiology clinics within SRFCs to improve underserved patients' access to imaging and overall delivery of healthcare.

#### Acknowledgements

The authors would like to acknowledge the faculty/staff of the UC San Diego Free Clinic for their continued partnership.

#### Disclosures

The authors have no conflicts of interest to disclose.

#### References

1. Lurie N, Dubowitz T. Health disparities and access to health. *JAMA*. 2007 Mar 14;297(10):1118-21. [LINK](#)

2. Taylor TD, Choudhury KR, Tong BC, et al. Geographic access to CT for lung cancer screening: a census tract-level analysis of cigarette smoking in the United States and driving distance to a CT facility. *J Am Coll Radiol*. 2019 Jan;16(1):15-23. [LINK](#)
3. Ahmed AT, Welch BT, Brinjikji W, et al. Racial disparities in screening mammography in the United States: a systematic review and meta-analysis. *J Am Coll Radiol*. 2017 Feb;14(2):157-165.e9. [LINK](#)
4. Press R, Carrasquillo O, Sciacca RR, Giardina EG. Racial/ethnic disparities in time to follow-up after an abnormal mammogram. *J Womens Health (Larchmt)*. 2008 Jul-Aug;17(6):923-30. [LINK](#)
5. Payne NR, Puumala SE. Racial disparities in ordering laboratory and radiology tests for pediatric patients in the emergency department. *Pediatr Emerg Care*. 2013 May;29(5):598-606. [LINK](#)
6. Waisel DB. Vulnerable populations in healthcare. *Curr Opin Anaesthesiol*. 2013 Apr;26(2):186-92. [LINK](#)
7. Dako F, Erkmén C, Cohen G, Belden C. The long arms of radiology: emergence of radiologists as public health practitioners. *J Am Coll Radiol*. 2017 Feb;14(2):185-7. [LINK](#)
8. Beck E. The UCSD student-run free clinic project: trans-disciplinary health professional education. *J Health Care Poor Underserved*. 2005 May;16(2):207-19. [LINK](#)
9. Smith S, Thomas R, 3rd, Cruz M, et al. Presence and characteristics of student-run free clinics in medical schools. *JAMA*. 2014 Dec 10;312(22):2407-10. [LINK](#)
10. Moore CL, Copel JA. Point-of-care ultrasonography. *N Engl J Med*. 2011 Feb 24;364(8):749-57. [LINK](#)
11. Toscano M, Szlachetka K, Whaley N, Thornburg LL. Evaluating sensitivity and specificity of handheld point-of-care ultrasound testing for gynecologic pathology: a pilot study for use in low resource settings. *BMC Med Imaging*. 2020 Oct 27;20(1):121. [LINK](#)
12. Kirkpatrick JN, Davis A, Decara JM, et al. Hand-carried cardiac ultrasound as a tool to screen for important cardiovascular disease in an underserved minority health care clinic. *J Am Soc Echocardiogr*. 2004 May;17(5):399-403. [LINK](#)
13. Wlodarkiewicz C, Adams J, Kondrashova T. Educational value of ultrasonography used as a diagnostic tool by medical students at a student-run free clinic. *Mo Med*. 2020 Sep-Oct;117(5):475-479. [LINK](#)
14. Bahner DP, Goldman E, Way D, Royall NA, Liu YT. The state of ultrasound education in U.S. medical schools: results of a national survey. *Acad Med*. 2014 Dec;89(12):1681-6. [LINK](#)
15. Tadros A, Manning P, Smitaman E, et al. Starting a free ultrasound clinic for the underserved: considerations and overcoming challenges. *Acad Radiol*. 2021 Jul;28(7):938-943. [LINK](#)
16. Hendee WR, Becker GJ, Borgstede JP, et al. Addressing overutilization in medical imaging. *Radiology*. 2010 Oct;257(1):240-5. [LINK](#)
17. Emanuel EJ, Fuchs VR. The perfect storm of overutilization. *JAMA*. 2008 Jun 18;299(23):2789-91. [LINK](#)
18. Litkowski PE, Smetana GW, Zeidel ML, Blanchard MS. Curbing the urge to image. *Am J Med*. 2016 Oct;129(10):1131-5. [LINK](#)