

## Original Research

# COVID-19 Needs Assessment and Support for Primary Care Practices in Western North Carolina

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## Abstract

### Background

It is critical to ensure that Primary Care Providers (PCPs) have adequate personal protective equipment (PPE), supplies, training, staffing, and contingency planning during pandemics, particularly in rural areas. In March 2020, during the onset of the COVID-19 pandemic, the Mountain Area Health Education Center (MAHEC), in collaboration with the Cecil G. Sheps Center for Health Services Research at UNC Chapel Hill, rapidly created and conducted a needs assessment of PCPs in western North Carolina (WNC).

### Methods

A group of twenty volunteers conducted a telephone survey of PCPs in a 16 county region of WNC. Practices were asked about their COVID-19 testing and telehealth offerings, PPE adequacy, and capacity to continue serving patients. The survey's emergency alert feature linked practices to immediate support. Descriptive data were generated to identify regional needs.

### Results

Out of 110 practices, 48 (43.6%) offered COVID-19 testing, with testing more common in rural counties (56.3% vs 33.9%). Telehealth services, including phone-only visits, were offered by almost all practices (91.8%). PPE needs included N-95 respirators (49.1%), face shields (45.5%), and staff gowns (38.2%). Rural practices were more likely to report the need for PPE. Assistance was requested for staff member childcare (34.5%) and providing or billing for telehealth (31.8%). The most urgent practice requests were related to finances, PPE, and telehealth. MAHEC's Practice Support team linked practices to virtual coaching, tip sheets, case-based video didactics and communication forums, and newsletters.

### Conclusion

During a pandemic, it is crucial to ensure that PCPs can continue to serve their patients. A rapid needs assessment of PCPs can allow for immediate and ongoing support that matches regional and practice-specific needs. Rural practices may require more assistance than their urban counterparts. Our rapid survey process jumpstarted a statewide system for enhanced communications with PCPs to better prepare for future emergencies.

### Keywords

COVID-19; pandemic preparedness; coronavirus infections; pandemics; primary care physicians; personal protective equipment; needs assessment; disaster planning

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## Background

On March 11, 2020, the World Health Organization declared the novel strain of coronavirus (COVID-19) a worldwide pandemic.<sup>1</sup> The Executive Office of the President of the United

States declared COVID-19 a national emergency on March 13, 2020.<sup>2</sup> As cases in the United States increased rapidly, concern emerged regarding limited supplies of personal protective equipment (PPE), access to ventilators,

sanitation equipment and health care facility preparedness.<sup>3-5</sup> Shortages of essential PPE greatly increased the risk of infection for front-line health care workers treating critically ill patients hospitalized with COVID-19.<sup>6</sup>

Early stage pandemic health care concerns emphasized lack of hospital capacity and preparedness, with less focus on primary care practice (PCP) needs and infrastructure.<sup>7-9</sup> PCPs are the initial point of contact for many patients potentially exposed to COVID-19, particularly in rural populations, which comprise 20% of the country's population.<sup>10</sup> A pandemic response necessitates that PCPs, especially rural clinics with fewer resources and support, have appropriate PPE supplies, training, staffing and contingency planning.<sup>8</sup>

Historically, pandemic planning and coordination has proven to be a challenge in primary care settings due to the autonomous nature of the specialty.<sup>10</sup> Challenges in stocking appropriate PPE, disaster planning, estimation of threats, implementing business continuity plans (BCP) and staffing have rendered PCPs ill-equipped to protect staff, treat patients and remain open during times of uncertainty.<sup>11,12</sup> Fortunately, researchers have reported that providing health care workers with PPE and preparedness training can enhance willingness to work.<sup>13,14</sup> Therefore, understanding capacity, preparedness, barriers and limitations that rural PCPs face during the COVID-19 pandemic is essential to addressing current and future population health care needs.

The Mountain Area Health Education Center (MAHEC) located in Asheville, North Carolina, was established in 1974 to improve training and retention of health care professionals in largely rural regions within 16 counties in western North Carolina (WNC). In March 2020, MAHEC, in collaboration with the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill (Sheps Center), rapidly designed and implemented a COVID-19 needs assessment of PCPs in WNC. WNC did not develop large case numbers of COVID-19 in the initial phases of the pandemic and had less than 100 cumulative cases in the 16-county region by April 1st.<sup>15</sup> Actual cases and prevalence were unknown at the time due to national shortages of supplies of test kits and reagents.<sup>16</sup>

Results were analyzed to assess regional trends of need, to develop trainings and tools, and to connect individual practices with requested support. In this work, we describe the needs of PCPs in WNC early in the COVID-19 pandemic. We also demonstrate the manner in which our rapid survey process contributed to a mechanism for an informed response and established ongoing communication within a regional network.

## Methods

### Survey Instrument

To ensure the findings met the needs of a range of audiences, input on survey content was obtained from and reviewed by Sheps Center researchers, UNC Health Sciences at MAHEC survey researchers, MAHEC Practice Support coaches and NC Area Health Education Centers leadership. The survey consisted of both closed- and open-ended questions to ensure that information was gathered about unanticipated needs. Practices were asked whether they currently offered COVID-19 testing and/or telehealth, about the adequacy of their COVID-19 related equipment and supplies (e.g., N95 respirators, disposable gowns), specific testing, training and support needs for managing possible and confirmed COVID-19 cases, and the type of support needed regarding providing and billing for telehealth services.

### Setting

The needs assessment was set in WNC, identified here as a 16-county region in Southeastern Appalachia. WNC has approximately 786,000 residents, ranging from 8,500 in the lowest-populated county to 254,000 in the county with the highest population.<sup>17</sup> While the regional population is comprised primarily of white residents (90%), wide county-level variability exists in terms of racial and ethnic composition. One WNC county has a significant Native American population (30%), and another county has a 10% African American population. The percentage of the population below the poverty level ranges widely among counties, from 12% to 19%, with a regional average of 14%.<sup>18</sup>

### Survey Population

A comprehensive contact list was created of all PCPs and health departments in the 16 counties of WNC served by MAHEC by combining

lists from MAHEC Practice Support with both regional and statewide care networks. “Primary care” was defined as practices that provided outpatient family medicine, internal medicine, obstetrics/gynecology and/or pediatric primary care. Responding practices included independently-owned practices, Federally Qualified Health Centers (FQHCs), Rural Health Clinics (RHCs), Free Clinics and health departments. Interviewers’ focus turned to independent practices after discovering quickly that the larger health system practices already had processes of support in place and in some cases were hesitant to provide information without getting permission and/or engaging their organizational leadership. Practice lists were reviewed by experts in primary care research (KM, JRH) and additional web-based searching was done when it was unclear if a practice delivered primary care. After duplicates and many large health system practices were removed from the list, 232 unique PCPs were identified. The study was determined to be non-human subjects research by the Institutional Review Board of the University of North Carolina, Chapel Hill.

### Survey Administration and Tracking

A group of twenty volunteer interviewers, comprised of UNC-Chapel Hill medical students conducting their clinical rotations on MAHEC’s campus (13), Sheps Center staff (2) and MAHEC staff (5), reached out to practices via telephone. Medical students were on leave from clinical rotations due to COVID-19 and PPE shortages, allowing time to participate. Two medical students led the coordination of the recruitment, training and organization of the volunteers.

The Sheps Center rapidly developed a web-based survey and tracking system. Additionally, an emergency alert “red button” feature was included in the web-based tracking system. Thus, when critical needs were identified, like a need for PPE or COVID-related financial assistance, the interviewer could immediately communicate with an experienced Practice Support team member.

Volunteers were trained in calling and data entry via a Zoom (Zoom Video Communications, Inc., San Jose, CA) training session. Volunteers, survey developers and web application programmers participated in regular Zoom

“huddles” that allowed for clear communication about common problems arising on calls, enabling quick and consistent solutions. Call priority was initially based on which practices were considered most vulnerable to closure in the short term or were not integrated with existing practice support systems within MAHEC. When calling practices, interviewers requested to speak with the practice manager or another staff member knowledgeable about supply availability, training needs and practice protocols. Callers were asked to leave three messages or voicemails, 48 work hours apart, when a practice manager could not be reached. On the fourth unanswered call, the caller identified the practice as “unreachable” in the tracking system. Practice locations that shared a practice manager were also noted.

### Ongoing Dissemination

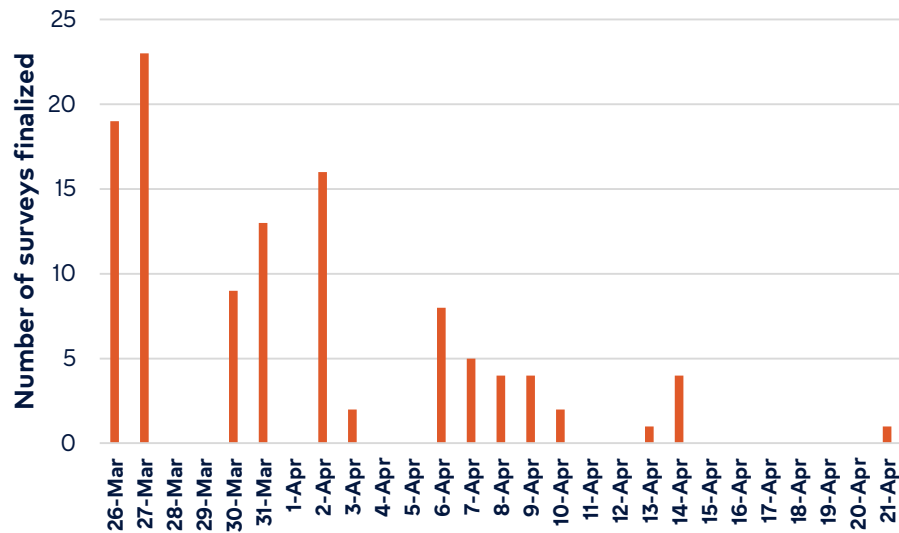
We shared results regionally as surveys were completed to inform partners and to help promote an early, regional support system. To this end, we established a website with rolling updates highlighting practice needs.<sup>19</sup> Care was taken to maintain anonymity but also demonstrate regional needs for PPE, telehealth support, training needs and financial resources. The website allowed for visualization in the form of interactive maps and tables. Tableau Desktop (Tableau Software, LLC, Seattle, WA) and SAS v9.4 (SAS Corporation, Cary, NC) analytic programming were utilized for information display.

### Data Analysis

For descriptive purposes, practices were classified by specialty, number of providers and practice type, information obtained through web searches and authors’ knowledge of WNC primary care (KM, JH). Practices were also stratified by rurality of practice location, with rural-urban continuum codes of 1-3 considered urban and 4-9 considered rural.<sup>20</sup> Practice location was mapped using Tableau. Two practices had duplicate surveys and thus, the first completed survey for each of these practices was used in analysis. All analyses were performed using SAS v9.4.

## Results

Practices were surveyed between March 26 and April 21, 2020, with almost 90% of survey

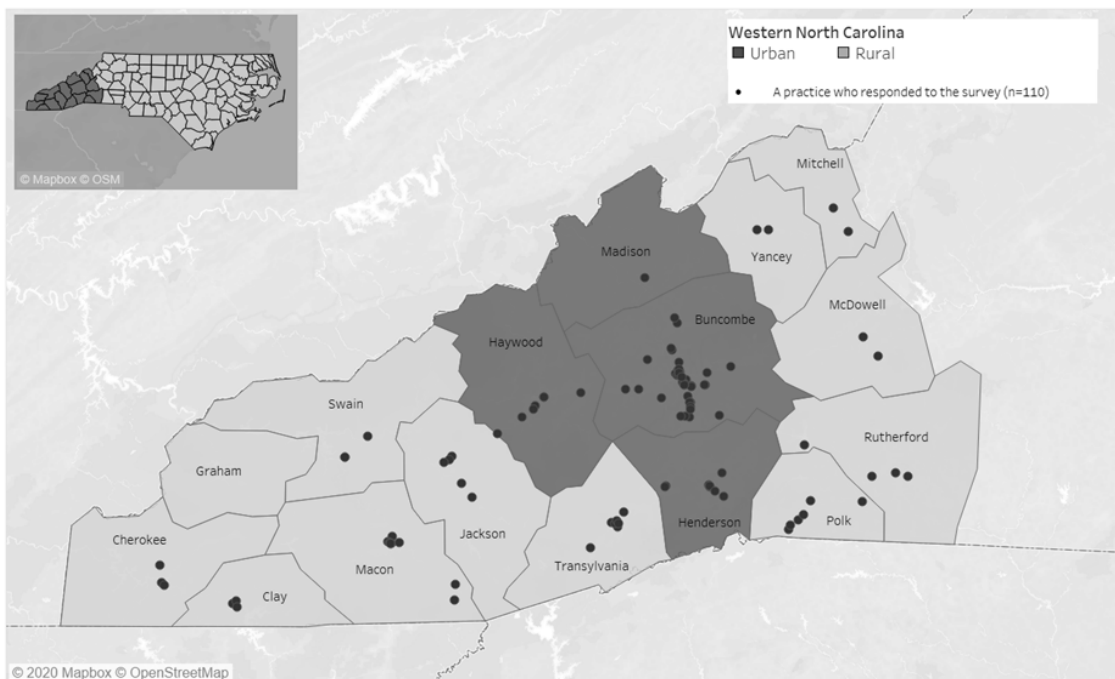


**Figure 1.** Dates of primary care practice COVID-19 needs assessment survey finalizations (n=110, March 26 to April 21, 2020).

completions occurring in the first 14 days. **(Figure 1)** Due to the urgency of assessing needs, we called practices as their contact information became available. Practices were added to the master list from different data sources until the final upload on April 12, 2020.

One hundred eleven practices from 15 of 16 counties responded to the phone survey. One practice, reporting that they were temporarily closed, was removed from the analysis. The

majority of the remaining 110 practices were independent practices (59, 53.6%) and family medicine practices (72, 65.5%). **(Table 1)** The median number of providers per practice was 4 (interquartile range 2–7), though this information was missing for 23 practices. Sixty-two (56.4%) practices were located in urban counties while 48 (43.6%) were in rural counties. **Figure 2** shows the geographical distribution of responding practices. Forty-eight practices (43.6%) reported offering COVID-19 testing



**Figure 2.** Location of primary care practices that responded to the COVID-19 needs assessment survey.

**Table 1.** Practice characteristics of survey respondents.

	<b>Total (n=110)</b>	<b>Urban (n=62)</b>	<b>Rural (n=48)</b>
<b>Practice Type</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
FQHC/Rural health clinic/Free clinic	11 (10.0)	6 (9.7)	5 (10.4)
Health department	10 (9.1)	2 (3.2)	8 (16.7)
Independent practice	59 (53.6)	38 (61.3)	21 (43.8)
Owned/managed by large health system	30 (27.3)	16 (25.8)	14 (29.2)
<b>Practice Specialty</b>			
Family Medicine	72 (65.5)	36 (58.1)	36 (75.0)
Internal Medicine	6 (5.5)	3 (4.8)	3 (6.3)
Obstetrics/Gynecology	14 (12.7)	12 (19.4)	2 (4.2)
Pediatrics	9 (8.2)	6 (9.7)	3 (6.3)
Multi-specialty/Other	9 (8.2)	5 (8.1)	4 (8.3)
<b>Provider* Number</b>			
Median (IQR)	4 (2-7)	5 (2-7)	3 (1-5)
<b>COVID Testing and Telehealth</b>			
Currently providing COVID-19 testing	48 (43.6)	21 (33.9)	27 (56.3)
Currently providing telephone or telehealth services	101 (91.8)	61 (98.4)	40 (83.3)

IQR=interquartile range

\*Providers include medical doctors, doctors of osteopathic medicine, nurse practitioners, physician assistants, and certified midwives; this information was missing for 9 practices in urban counties and 14 practices in rural counties.

in their clinic. Of note, more than half of practices located in rural counties offered testing (56.3%), compared to one-third of practices in urban counties (33.9%). Telephone or video-based visits were offered by all but one urban-located practice (98.4%) and by 40 of the 48 (83.3%) rural-located practices.

Many practices reported not having enough or being unsure of their PPE and safety supplies for the 2 weeks following their survey response, ranging from 54 (49.1%) without enough N95 respirators to 16 (14.5%) reporting needs for single use gloves. (**Table 2**) Rural practices were more likely than urban practices to report a 2-week need for all PPE and safety supply items. Overall, the numbers of practices in need or unsure of need increased substantially when queried on a 4 week supply, ranging from 84 (76.4%) needing N95 respirators to 48 (43.6%) without enough single use gloves.

In an open-ended query on needs, 20 practices also reported not having enough disinfectant/cleaning supplies; other needs included thermometers and covers, COVID testing supplies, fit testing kits, bouffant caps and shoe covers.

More than one-third (38, 34.5%) of respondents said they did not have resources to help staff members with childcare and would like support. Assistance with providing or billing for telehealth was the next most mentioned area of need (35, 31.8%). Practices also placed a high priority on learning how to support and refer patients with substance use disorders (30, 27.3%) and other social service needs (27, 24.5%), as well as training in the use of N95 respirators (26, 23.6%) and staff shortage issues (24, 21.8%). (**Table 3**) Encouragingly, only 4.5% of practices requested assistance with directing suspected cases to screening locations and only 9.1% of practices requested guidance



**Table 2.** Two- and four-week personal protective equipment and supply needs.\*

	Total (n=110)		Urban (n=62)		Rural (n=48)	
	2 Week Needs	4 Week Needs	2 Week Needs	4 Week Needs	2 Week Needs	4 Week Needs
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<b>N95 respirators</b>	54 (49.1)	84 (76.4)	25 (40.3)	43 (69.4)	29 (60.4)	41 (85.4)
<b>Face shields</b>	50 (45.5)	72 (65.5)	26 (41.9)	38 (61.3)	24 (50.0)	34 (70.8)
<b>Surgical masks</b>	34 (30.9)	69 (62.7)	12 (19.4)	37 (59.7)	22 (45.8)	32 (66.7)
<b>Staff gowns</b>	42 (38.2)	74 (67.3)	23 (37.1)	41 (66.1)	19 (39.6)	33 (68.8)
<b>Hand sanitizer</b>	32 (29.1)	57 (51.8)	12 (19.4)	29 (46.8)	20 (41.7)	28 (58.3)
<b>Single use gloves</b>	16 (14.5)	48 (43.6)	6 (9.7)	24 (38.7)	10 (20.8)	24 (50.0)

\* Individuals who answered “no, we do not have enough” and “unsure if we have enough” to each supply

on helping patients who had tested positive for COVID-19. Rural practices were more likely than urban practices to request assistance or training, with the exception of staff childcare resources, training in the use of N95 respirators and directing suspected cases to screening locations.

The most urgent requests identified via the emergency Red Button were for assistance with finances and PPE, followed by telehealth. When support was requested through the survey Red Button, the Practice Support team assigned a training coach to the practice, who provided technical assistance, PPE advice and educational support within 24 hours. Follow-up communication consisted of ongoing contact with clinics on a weekly basis to ensure that their needs were fully resolved. Not only was the information obtained through the Red Button directly applicable to the practice in need, but the Practice Support team used the Red Button data to create tailored technical assistance tools to support emerging needs. Communication vehicles for further dissemination of support included: 1) Tip Sheets provided via email and MAHEC's website on PPE, NCCare 360 (NC network that helps providers electronically connect patients to community resources), financial assistance and telehealth; 2) ECHO (case-based video conferences with brief didactics and regional communication forums) series on telehealth (3 days a week), NCCare 360 (weekly) and social determinants of health (weekly); 3) virtual visits with a practice coach; 4) weekly email

newsletter. MAHEC's Practice Support team followed up with non-flagged needs after receiving the final data from the Sheps Center.

## Discussion

As a regional source of education and practice support, MAHEC, in collaboration with the Sheps Center, quickly reached out to PCPs in WNC with a needs assessment survey to identify PPE and safety supply shortages, practice management support and training needs unique to COVID-19. Once needs were identified, MAHEC's Practice Support team linked practices to virtual coaching, tip sheets, case-based video didactics and communication forums, and weekly newsletters.<sup>21</sup> This process identified regional needs specific to COVID-19 and also made evident needs for future preparedness, a salient outcome as the caseload in WNC has rapidly grown.<sup>15</sup>

PPE and safety supplies were a major concern among WNC practices, with the most pronounced need for N95 respirators, face shields and staff gowns. All queried PPE needs were more common for practices in rural counties, but the disparity was especially evident for N95s, surgical masks and alcohol-based hand sanitizer. Only one-third of practices reported having a full complement of queried PPE and safety supplies available for the two weeks following survey completion. Approximately half of practices identified at least one PPE need within the next two-week period, with more than three-quarters identifying a need in the following four weeks.

**Table 3.** Requested training and assistance needs.

	<b>Total (n=110)</b>	<b>Urban (n=62)</b>	<b>Rural (n=48)</b>
<b>Training or Assistance Requested</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
Staff childcare resources*	38 (34.5)	24 (38.7)	14 (29.2)
Support for providing or billing for telehealth†	35 (31.8)	19 (30.6)	16 (33.3)
Assistance in creating a process for caring for patients who need support specific to substance abuse disorders*	30 (27.3)	16 (25.8)	14 (29.2)
Assistance in creating a referral process for patients with social service needs*	27 (24.5)	13 (21.0)	14 (29.2)
Training in use of N95 respirators‡	26 (23.6)	16 (25.8)	10 (20.8)
Training in how to deal with staff shortages‡	24 (21.8)	12 (19.4)	12 (25.0)
Training on COVID-19 testing eligibility criteria‡	14 (12.7)	5 (8.1)	9 (18.8)
Training on performing nasal swab diagnostic testing‡	12 (10.9)	4 (6.5)	8 (16.7)
Training on directing suspected COVID-19 cases to testing sites‡	11 (10.0)	6 (9.7)	5 (10.4)
Assistance in developing procedure to direct patients who have tested positive for COVID-19 to help*	10 (9.1)	4 (6.5)	6 (12.5)
Assistance in developing protocol to direct suspected cases to appropriate screening locations*	5 (4.5)	3 (4.8)	2 (4.2)

\* Individuals who answered “no we do not have this and we do need assistance” or “unsure” to the question: “Now I am going to ask you about a few procedures/protocols at your practice and ask if you and/or member of your practice would like to receive assistance with such items.”

† Individuals who answered “yes” or “unsure” to the question: “Do you need help with providing and/or billing for telephone/telehealth services?”

‡ Individuals who answered “yes” or “unsure” to the question: “Would any members of your practice like to receive training on...”

Our data on the shortage of PPE in WNC mirrors national data from the “Quick COVID-19 Primary Care Survey” conducted weekly by The Larry A. Green Center in partnership with The Primary Care Collaborative.<sup>22</sup> In their weekly survey collected at the same time of our needs assessment, 58% of clinicians reported a lack of PPE.<sup>22</sup> In a NC statewide primary care needs assessment survey fielded shortly after the MA-HEC regional survey was deployed (unpublished results), among 607 respondents, 95% noted having fewer than 20 days supply of critical PPE. Our team is currently engaged in a follow up survey (July–August, 2020) of these same practices to understand and address current needs. Additionally, the Practice Support team continues to provide weekly newsletters, tip sheets and links to request PPE from state and regional resources

To keep patients and staff safe and maintain patient volume when COVID-19 was declared a national emergency,<sup>2</sup> practices were quickly transitioning to telehealth and navigating new Medicare and Medicaid telehealth billing rules.<sup>23</sup> At the time of the survey, almost all practices located in urban areas were providing telehealth and/or telephone services, while rural practices were slightly less likely to have transitioned. Telehealth challenges, such as low reimbursement and internet connectivity issues, have plagued practices nationally as well.<sup>22</sup> In the early stages of the pandemic, over half of nationally surveyed clinicians reported high levels of stress related to the provision of virtual health care.<sup>22</sup> Thus, it was no surprise that assistance with providing or billing for telehealth was the most highly requested training need in our population. The practice support team addressed this need by creating a thrice-weekly video conference series on telehealth.

Research has shown that support for personal and family needs are a source of anxiety for health care professionals during the pandemic response.<sup>24</sup> Our survey highlighted how these issues manifest themselves as staffing concerns. With the widespread closure of schools and childcare centers in WNC, childcare for staff was identified as an immediate and unsettled need. Additionally, at least one of our smaller practices reported concerns about staffing if employees were to get sick, echoing national trends.<sup>22</sup>

As discussed, 44% of WNC practices reported providing COVID-19 testing at the time of the survey. During a similar timeframe, nationally, approximately 70% of clinicians reported working at practices with some COVID-19 testing capacity.<sup>22</sup> In WNC, availability was more common in rural counties, perhaps due to the high presence of health departments, FQHCs, Rural Health Clinics and Free Clinics. Encouragingly, the majority of practices felt prepared to direct suspected cases to screening locations and to assist patients who had tested positive for COVID-19.

Through the process of developing and implementing the survey, we also recognized opportunities to improve regional emergency preparedness among PCPs. The initial lack of a comprehensive, updated and accurate list of practices in WNC hindered our ability to rapidly reach out to all practice managers. An unintended, positive outcome of our work was the recognition of the need to maintain a more robust list of regional practices. In response to this identified need, Sheps Center, through collaboration with state partners, has received funding to maintain an up-to-date master list of all North Carolina health care practices for the purposes of emergency response.

Another beneficial outcome of the needs assessment was that MAHEC's Practice Support team added more than 60 practices to their contact list for regional communications. Increasing regional awareness of MAHEC's Practice Support team is helping to facilitate communication with rural practices during the ongoing pandemic. Importantly, the survey process also strengthened relationships between state and regional partners to further emergency preparedness.

## Limitations

Given the rapid implementation of this project, there were limitations. As stated, there was not a centralized, updated contact list for PCPs. This created challenges during the data collection and analysis process, including the need for repeated de-duplication of lists and ensuring the veracity of practice names, addresses and contact information. Likely some of our smaller, newer or more rural practices were missed. Additionally, the exclusion of some practices owned or managed by larger healthcare systems may have resulted in an overestimate of needs in our region.

## Conclusions

Public health emergencies necessitate rapid data collection to assess current and future needs of PCPs, which are often the first point of contact for patients exposed or infected with COVID-19.<sup>10</sup> A regional practice-based needs assessment demonstrated urgent gaps in the provision of primary care posed by the pandemic. Integration of MAHEC's Practice Support team into the needs assessment at the front end ensured that regional training efforts were tailored to regional needs and practices could be linked to individualized support. Additionally, our rapid survey process jumpstarted a statewide system for enhanced communications with PCPs to better prepare for future emergencies.

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## Conflicts of Interest

Dr. Cass reports a contract with Mountain Area Health Education Center, grants from North TraCS CTSA, and other funding from the North



Carolina Biotechnology Center Gift and Land of Sky Gift during the conduct of the study.

The other authors declare they have no conflicts of interest.

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## References

1. World Health Organization. Coronavirus disease 2019 (COVID-19): situation report 51. Published March 11, 2020. Accessed May 1, 2020. [https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57\\_10](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_10)
2. The White House. Proclamation on declaring a national emergency concerning the novel coronavirus disease (COVID-19) outbreak. Accessed May 1, 2020. <https://www.whitehouse.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/>
3. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19) in the U.S. Published April 29, 2020. Accessed May 1, 2020. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html>
4. Grimm CA. Office of Inspector General. United States Department of Health and Human Services. Hospital experiences responding to the COVID-19 pandemic: results of a national pulse survey March 23–27, 2020. Published April 2020. <https://www.oversight.gov/sites/default/files/oig-reports/oei-06-20-00300.pdf>
5. Cavallo JJ, Donoho DA, Forman HP. Hospital capacity and operations in the coronavirus disease 2019 (COVID-19) pandemic—planning for the Nth patient. *JAMA Health Forum*. 2020;1(3):e200345–e200345. <https://doi.org/10.1001/jamahealthforum.2020.0345>
6. National Nurses United. Survey of nation's frontline registered nurses shows hospitals unprepared for COVID-19. Published March 5, 2020. Accessed May 1, 2020. <https://www.nationalnursesunited.org/press/survey-nations-frontline-registered-nurses-shows-hospitals-unprepared-covid-19>
7. Schmidt JM. Seeking evidence-based COVID-19 preparedness: A FEMA framework for clinic management. *NEJM Catal Innov Care Deliv*. 2020 March;1(2):1-15. <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0079>
8. Tomizuka T, Kanatani Y, Kawahara K. Insufficient preparedness of primary care practices for pandemic influenza and the effect of a preparedness plan in Japan: a prefecture-wide cross-sectional study. *BMC Fam Pract*. 2013;14(1):174. <https://doi.org/10.1186/1471-2296-14-174>
9. Wynn A, Moore KM. Integration of primary health care and public health during a public health emergency. *Am J Public Health*. 2012;102(11):e9–e12. <https://doi.org/10.2105/AJPH.2012.300957>
10. Lauer J, Kastner J, Nutsch A. Primary care physicians and pandemic influenza: an appraisal of the 1918 experience and an assessment of contemporary planning. *J Public Health Manag Pract*. 2008;14(4):379–386. <https://doi.org/10.1097/O1.PHH.0000324567.10652.db>
11. Hashikawa M, Gold KJ. Disaster preparedness in primary care: ready or not? *Disaster Med Public Health Prep*. 2018;12(5):644–648. <https://doi.org/10.1017/dmp.2017.136>
12. Qureshi K, Gershon RRM, Sherman MF, et al. Health care workers' ability and willingness to report to duty during catastrophic disasters. *J Urban Health*. 2005;82():378–388. <https://doi.org/10.1093/jurban/jti086>
13. Shapira Y, Marganitt B, Roziner I, et al. Willingness of staff to report to their hospital duties following an unconventional missile attack: a state-wide survey. *Isr J Med Sci*. 1991;27(11-12):704–711.
14. Qureshi KA, Merrill JA, Gershon RR, Calero-Breckheimer A. Emergency preparedness training for public health nurses: a pilot study. *J Urban Health*. 2002;79(3):413–416. <https://doi.org/10.1093/jurban/79.3.413>
15. North Carolina Department of Health and Human Services. COVID-19 North Carolina dashboard. Accessed August 25, 2020. <https://covid19.ncdhhs.gov/dashboard>
16. Weaver C, Ballhaus R. Coronavirus testing hampered by disarray, shortages, backlogs. The Wall Street Journal. Published April

- 19, 2020. Accessed August 25, 2020. <https://www.wsj.com/articles/coronavirus-testing-hampered-by-disarray-shortages-backlogs-11587328441>
17. United States Census Bureau. 2020. American Community Survey demographics and housing estimates: 2018 ACS 5-year estimates. Accessed August 25, 2020. <https://www.census.gov/programs-surveys/acs/technical-documentation/table-and-geography-changes/2018/5-year.html>
  18. United States Census Bureau. 2020. Poverty status in the past 12 months: 2014-2018 American Community Survey 5-year estimates. Accessed August 25, 2020. <https://www.census.gov/programs-surveys/acs/technical-documentation/table-and-geography-changes/2018/5-year.html>
  19. Mountain Area Health Education Center. WNC primary care COVID impact and assessment survey. Published 2020. Accessed August 5, 2020. <https://pub.mahec.net/sites/pages/covid-survey>
  20. United States Department of Agriculture. Economic Research Service. Rural-urban continuum codes. Accessed July 18, 2020. <https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation/>
  21. University of New Mexico Health Sciences Center. Project ECHO. Published 2019. Accessed July 23, 2020. <https://echo.unm.edu/>
  22. Primary Care Collaborative. Quick COVID-19 primary care weekly survey, Weeks 1-4. Accessed August 5, 2020. <https://deepblue.lib.umich.edu/handle/2027.42/154717>
  23. CMS. Medicare Telemedicine Health Care Provider Fact Sheet. Published March 17, 2020. Accessed May 1, 2020. <https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet>
  24. Shanafelt T, Ripp J, Trockel M. Understanding and addressing sources of anxiety among health care professionals during the COVID-19 pandemic. *JAMA*. 2020;323(21):2133-2134. <https://doi.org/10.1001/jama.2020.5893>