Virtually Connecting Corpsmen, Providers, and Patients to Increase Readiness

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ABSTRACT

Engineers from the Johns Hopkins University Applied Physics Laboratory (APL) collaborated closely with the Navy Bureau of Medicine and Surgery to conduct essential research, analysis, design, integration, and testing and evaluation of a new care delivery model for active-duty service members. APL engineers established relationships with their colleagues at all levels of the Navy Bureau of Medicine and Surgery. These relationships proved to be critical in the engineers' understanding of stakeholder requirements, while a tailored systems engineering approach created a learning model to meet the needs of the population. Through systems and industrial engineering, APL was able to implement a proof of concept that demonstrated a scalable, long-term connected health solution for Navy Medicine.

INTRODUCTION

In 2016, the Navy surgeon general's strategic plan indicated a need to increase the convenience of and access to health care to focus on readiness and operational requirements. To address this need, a team from the Navy Bureau of Medicine and Surgery (BUMED) and APL met in response to an article written by the dean of the School of Medicine at the Uniformed Services University of the Health Sciences to better understand the concerns about the future of primary care in America. The research highlighted a shortage of the medical professionals needed to provide adequate care for patients, specifically those in rural environments.[1] An even greater concern was that state and local governments were not leveraging former military medical professionals to meet that need. Their ability to serve in various environments and treat a wide variety of patient populations as an extension to licensed medical providers would provide a critical capability lacking in today's health care domain. On a similar note, the team discussed that current Navy hospital corpsmen (HMs) have the skills for a career in health care and have served in the most tumultuous environments, highlighting their resilience in providing high-quality, patient-centered care. The team used that evidence and began analyzing the needs of the population as well as current policy to better formulate a recommendation for BUMED leadership.

In the spring of 2017, the Navy surgeon general, Vice Admiral Forrest Faison, made the implementation of a Connected Corpsmen in the Community (CCC) proof of concept a high-priority initiative for Navy Medicine. The initiative emphasized ensuring a medically ready force and a ready medical force through patient-centered care in an environment based outside military treatment facilities and connected to a hub of virtual care. Enlisted medical staff have long served as first responders in wartime and provide primary care on ships and in remote locations. Between deployments, these skilled providers often do not use these capabilities to their fullest capacity, putting their training and skills at risk of degradation and diminishment and threatening readiness. This initiative provided a way for HMs to use their skills to the fullest extent of their abilities, including having them treat patients outside of hospitals and clinics.

A proof of concept for this surgeon general initiative was executed from September 2017 through October 2018. It was designed in collaboration with HMs, independent duty corpsmen (IDCs), medical officers, and licensed independent practitioners (LIPs), with input from regional commands and BUMED leadership and with support from APL health systems engineers and analysts. HMs provide treatment for sailors and marines, assist physicians and dentists with surgeries, and transport the sick and injured to safe quarters. They can specialize in radiology, search and rescue, or preventative medicine.[2] IDCs are specialized HMs often serving in environments where no medical officer is assigned. "IDCs fulfill a variety of critical duties in support of the U.S. Navy and Marine Corps mission. They serve as clinical or specialty technicians in more than 38 occupational specialties, including key administrative roles at military treatment facilities around the world."[3]

Use of Data to Inform Decision-Making for Organizations

Rigorous training and close living quarters put many active-duty service members at greater risk of musculoskeletal injuries and infectious disease. Furthermore, aggressive schedules in austere environments make access to traditional clinic-based health care a challenge. With a choice between missing training or forgoing care, an active-duty service member may choose the latter and exacerbate their condition, potentially rendering them medically unfit for service. To increase convenience and access, the CCC concept would be placed on bases but outside of military treatment facilities to reduce the burden of travel, and it would be offered at times that ensured that patients could be seen without missing critical training. Additionally, the scope of the CCC's practice would reflect the needs of the populations of the sites served by CCC and would provide opportunities for HMs to treat conditions they would encounter while deployed to support a ready medical force.

Population Assessment—Identifying the CCC's Scope of Practice and Locations

Aligned with the core goal of enabling HMs to treat conditions they would encounter while deployed, key stakeholders had to determine CCC's scope of practice (i.e., which conditions could be treated by HMs). Chosen conditions had to be relevant to deployed medical practice while supporting the needs of the local patient population. International Classification of Diseases codes 9 and 10 were used as unique identifiers for high-volume, low-acuity conditions to query historical Navy Medicine appointment utilization data from the Military Health System Mart (M2) database. A weekly working group brought together BUMED leadership, military treatment facility leadership, HMs, the BUMED Public Affairs Office, and subject-matter experts in training development from Navy Medicine Education, Training, and Logistics Command. The working group meetings were held at Defense Health Headquarters and included a teleconference option for those who could not attend in person. Meetings were supported by APL engineers. The group reviewed the potential conditions to be considered in scope for CCC treatment and decided on a phased approach that would create a low-risk environment for the first phase. The group considered an initial list of 13 conditions before selecting triage and treatment of sprains, strains, joint pain, minor cuts, blisters, and wounds and removal of staples and sutures.

Using the same M2 data, the team conducted a population and needs assessment to determine locations for the first CCC sites. Several factors were considered in this process, including:

- Overall number of clinic encounters
- Number of encounters eligible for treatment (as identified above)
- Proportion of eligible encounters compared with overall encounters
- Active-duty service member population at potential sites

Using Tableau, M2 data were aggregated to create a heat map of military installations by encounter type and volume (Fig. 1). The map provided information on patient and condition volumes by location and allowed leadership to identify several potential proof-of-concept sites. Using the results of the analysis, BUMED leadership selected two sites to test the concept; the first was Pensacola, Florida, and this site was followed by Camp Pendleton, California.

Tracking Chief Complaints—Identifying Opportunities for Expanding Care

After implementation and to establish a baseline, the APL health systems engineers continuously monitored incoming data on patients' chief complaints to determine which conditions were most prevalent at Camp Pendleton during these first 6 months of the effort (Fig. 2). Chief complaints outside the developed algorithms were deemed out of scope for treatment by the HMs.

Figure 1. Heat map of eligible and overall active-duty service member patient encounters at military installations in the continental United States.

The first CCC location in Pensacola was located at the Naval Air Technical Training Center (NATTC), which is often the first duty station for new active-duty service members after boot camp. Many patients had no previous exposure to Florida's climate or insects, such as fire ants, and were presenting with adverse reactions to bites. Seasonal trends were also monitored, as an influx of patients presenting with cold/flu symptoms began in the late fall and early winter. By specifically monitoring and characterizing out-of-scope conditions for the entire proof of concept, APL health systems engineers were able to document trends that would shape future practice across all future sites (Fig. 3). After engineers presented this information to the working group, the group determined that it would be appropriate to add upper-respiratory infection symptoms and insect bites to the list of in-scope conditions to meet the needs of the patient population, avoid turning patients away for these conditions, and increase the scope of care offered. As HMs demonstrated proficiency and gained confidence through increased direct patient care, algorithms were also expanded to include care for nausea, vomiting, and diarrhea.

As the program expanded, the team evaluated differences in geographic and patient population needs, as

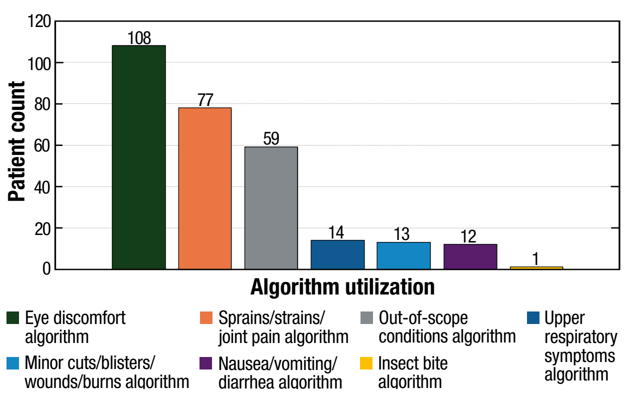

Figure 2. Patient chief complaints grouped by treatment algorithm.

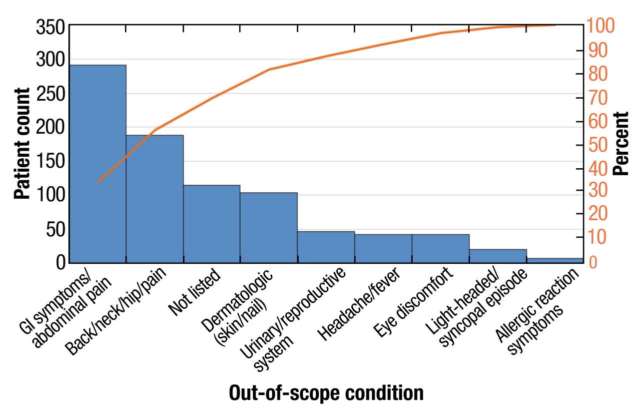

Figure 3. Current out-of-scope conditions tracked for potential inclusion in future algorithms.

well as stakeholder feedback, to ensure that site-specific requirements were addressed. Staffing variation by location raised immediate concerns regarding the 31 Area clinic location at Camp Pendleton, which did not have an LIP consistently available for virtual reach-back. After it was discussed with the working group, a modification to protocols allowed for an IDC to be in the clinical space with the HMs, thereby ensuring proper oversight. The patient population at 31 Area is exclusively Marine recruits whose medical needs differ from those of the schoolhouse population at NATTC. It was clear from early discussions with 31 Area staff that an algorithm for HMs to treat conjunctivitis was urgently needed. However, data showed that this condition was not prevalent in Pensacola, so it was not added to the scope of care. An algorithm for eye discomfort was approved for 31 Area, where conjunctivitis accounted for 36% of visits in the first 11 weeks of operations. Further testing for bacterial conjunctivitis of 23 recruits led to the identification of a specific strain for this population. Ongoing analysis of the patient volumes and scope was critical in identifying specific patient population nuances and needs.

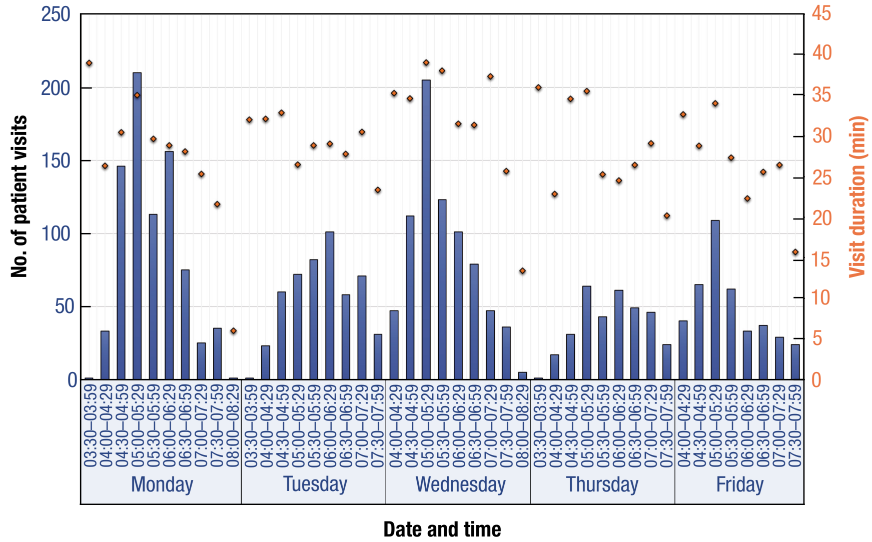

Figure 4. Patient visit count and duration of visit by time of day and day of week at NATTC during first year of implementation.

As shown in Fig. 4, patient volumes were highest on Monday and Wednesday, and although hours of operation were 4:00–08:00 a.m., most patients presented between 05:30 and 07:00 a.m. Tracking these data allowed stakeholders and leadership to determine whether the chosen days and hours of operation were appropriate. Further into the proof of concept, these data supported decisions to adjust the hours of operation and staffing ratios as needed according to seasonal variations or periodic trends in patient volume.

Increased Convenience and Access to Care—Robust and Adaptable Metrics

To ensure that access to care and patient convenience were addressed at the point of injury, treatment locations were placed in close proximity to training facilities. At the training commands, students unable to complete their intended instruction could be held back until the next session, which could be a month or even a year away. This delay in billet fulfillment could result in another service being diverted to meet critical operational needs. Therefore, CCCs operate outside of normal clinic and training hours, and time saved for the warfighter was a critical metric the team captured to show how this concept supports the resilience and readiness of active-duty service members who can receive medical care without missing vital duty or training time.

Metrics were data driven and designed with appropriateness and efficacy at measuring convenience and access to care. The first of these metrics was selected to assess patient utilization by time of day and day of week. Durations of patient visits were also captured to serve as a proxy measure for the model's ability to capture special-cause variation in patient volumes (Fig. 4).

COST AND RESOURCE MODELING

The team modeled costs and resources to understand the cost effectiveness and scalability of this care pathway. The model was developed for a single LIP operating remotely and covering a maximum of four facilities. The model employs capacity-controlled patient throughput and direct costing for the concept. Figure 5 illustrates the summary screen of the model.

The care an LIP provides is characterized by the average time spent per patient, a productivity factor, and the time between patient arrivals. This information defined the maximum number of patients that can be seen per hour, which the user can modify to better characterize the local constraints. The care an HM provides is characterized by the average time spent per patient and a productivity factor. The patient inter-arrival rate was not included given that HMs would only be supporting one site and the nondirect care time would be included in the facility characteristics. The facilities are characterized by the number of HMs, the number of beds, the days of operation, the sharing of the LIP's time, and the average percentage of capacity used.

INPUTS

Average LIP time with patient	2.5	minutes
Max acceptable patients/hour per LIP	17	Must be ≤ 17
LIP productivity %	85%	
Patient changeover downtime	0.5	minutes
Average HM time per patient	20.0	minutes
HM productivity %	85%	

LOCATION	NATTC	CORRY ST	NAME 3	NAME 4
Active locations (first location must be active)	Y	Y		
Number of HMs per location	3	2		
Number of beds per location	3	2		
Number of days per week open	5	5		
Hours per day of operation	4	4		
Operate at same peak times as other location(s)	Y	Y		
Average % of capacity used	80%	70%		
Available square feet	625	625		
Rental cost per square feet per month	$0.50	$0.50		

% total equipment/tech cost for recurring costs/yr	15%
Average supplies/medications cost per patient	$3.50

% that would have sought care at care UCC	3%
% that would have sought care at clinic	95%
% of previous that ended up being referred	50%
% that would have been seen outside MHS	2%
Training facility (Y or N)	Y

OUTPUTS

LOCATION	NATTC	CORRY ST	NAME 3	NAME 4
Active locations	Y	Y	N	N
Average patients per day	24	14	0	0
Average patients per hour	6	3.5	0	0
Max patients per day	30	20	0	0
Max patients per hour	7.5	5	0	0

	LIP			
Total patients per year	9500			
LIP capacity status		56%		
LIP patients per hour	10	13		
HMs per LIP	5		Max HMs (beds) per LIP	6

	Annual Costs		Possible Annual Savings
Staffing	$265,000	UCC	$45,600
Supplies/medications	$33,250	Clinic	$315,875
Recurring equipment	$17,170	Tricare	$142,500
Recurring facility	$7,500	Extended training	$236,906
TOTAL	$322,920	Intangibles	PRICELESS
COST PER PATIENT	$34	TOTAL	$740,881
		SAVINGS PER PATIENT	$78
Up-front costs	$130,827		

NET PER YEAR $417,962

PAYBACK PERIOD 4 months

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Figure 5. Cost–benefit model. UCC, urgent care center.

The patient throughput and the required staff variables are used to determine the annual recurring costs for the modeled care pathway. The annual recurring cost per location equals the sum of labor costs, consumable supply costs, and recurring equipment and facility costs. Savings accrued by shifting workload from the clinic to the CCC are presented as a separate calculation. The annual recurring costs are calculated as follows:

- Labor costs consist of the hours during which an LIP and HMs are supporting the concept multiplied by their labor rate, which includes the amount of paid benefits and assigned overhead. Though pharmacists support the concept, the amount of time they contributed to the concept model is considered negligible.
- Consumable supply costs are calculated by estimating the average cost of supplies used per patient multiplied by the number of patients seen per year. Items that are unique to each facility should be considered.
- Recurring equipment costs for equipment maintenance, leases, and depreciation are expressed as a percentage of the purchase cost of the equipment. The percentage selected is typically driven more by depreciation than maintenance. A 10-year replacement schedule would equate to 10%. Equipment with lease or service fees will be assigned a much higher percentage. Cell phones and technology maintenance/repair plans need to be evaluated separately.
- Facility costs are calculated by multiplying the location's square footage by the rental rate per square foot. If the concept is housed in an existing building without a designated rental rate, costs are equal to the total facility costs associated with the building multiplied by the percentage of the total building's square footage that is occupied by the location. Total facility costs include building depreciation, building maintenance, cleaning/laundry, utilities, insurance, and waste management.

Each patient treated under this model of care instead of the base health clinic or other health care setting is reducing costs. Three types of care settings are considered: base health clinic, urgent care center or emergency room, and purchased care covered under the TRICARE benefit. For the base health clinics, the savings are calculated from the percentage of patients who would have gone to those clinics multiplied by the cost for low-acuity patient care at that clinic. The number of patients who would have gone to the base health clinic is adjusted by the percentage who are referred to the clinic after seeking treatment through this concept. For emergency care, the savings are calculated from the percentage of patients who would have gone to an emergency room or urgent care center multiplied by the cost for high-acuity patient care at that command. For the patient who would have gone to a health care facility in the purchased care market, savings in TRICARE reimbursement will be realized.

The annual recurring costs are subtracted from the possible savings to determine the net cost gained or lost per year. This number, combined with the one-time up-front costs required to establish operations, is used to calculate a nonamortized payback period. The model can be used to evaluate multiple setups to determine the best-value option.

The cost–benefit model for the configuration at Naval Hospital Pensacola is presented in Fig. 5. Based on the presented cost data and labor rates, the net return is greater than $400,000 per year with a payback period of 4 months.

The cost–benefit model can also be used to estimate the potential long-term costs of operations. Assuming that three facilities are added per year and a conservative estimate of 20% is paid in up-front costs, and accounting for savings recognized from only the base health clinic, this concept would cost approximately $300,000 per year, with the potential for greater savings to be realized.

Improvements to the cost model can be made as the program expands. Future expansions can include simulation of multiple LIPs operating consecutively, accounting for different equipment, varied up-front costs per location, and a model of wait-time cost. Gaining the additional knowledge associated with the expansions will optimize start-up costs, optimize use of the LIP, and improve patient satisfaction.

FUTURE OF VIRTUAL HEALTH USING LESSONS LEARNED FROM THE PROOF OF CONCEPT

The term *telehealth technology* is increasingly being replaced with *virtual visits*, or *connected health*, and in the case of CCC all these terms apply. The concept has unique components that address the fourth component of the Military Health System (MHS) quadruple aim to promote force readiness.[4] As mentioned previously, the concept does this in two ways: enabling HMs to execute care protocols that they would otherwise not be able to execute in stateside clinical environments and enabling more convenient access to care for the active-duty service members who would otherwise have to schedule time away from their training or duty. This section provides a view of the technical solution and how it meets this need as well as what the proof-of-concept capabilities could portend for future capabilities to increase force readiness in field locations.

The enabling technology supporting the concept connects medical devices and video software between a remote LIP and the HM serving the patient. The virtual support from an LIP makes it feasible for HMs to practice the medicine they are trained for and expands the number of conditions that HMs can treat. Today this technology is being used primarily in three applications: (*i*) exam camera pictures for dermatology and injury assessment, (*ii*) exam camera video or pictures to diagnose upper-respiratory infection, and (*iii*) two-way video consultations between the LIP and the HM on duty and/or the patient.

Implementation of a connected health system to accomplish these tasks poses many challenges. Network connectivity must be solved for the local devices. Additionally, the wide area network for access to the electronic health record, the hosted encounter software, and video communications must be robust. Because the technology, the HM, and the supporting LIP are intended to be operationally mobile, wide area network connectivity becomes a particularly challenging task. Wireless mobile data services are the obvious choice, but they pose security challenges for MHS applications and do not always have the coverage and throughput to support quality two-way video, which requires a minimum of 512 kbps. In addition, sites might have different dominant telecommunication carriers, so the solution must account for a multicarrier implementation.

Medical device compatibility, interoperability, and remote connectivity also present challenges for robust connected health applications because of the fairly regular driver updates required for maintenance. Tethered USB devices are less convenient than wireless devices connecting over a personal area network. But Bluetooth, for example, can introduce compatibility challenges, which have led to implementation standards such as the *Continua Design Guidelines*.[5] The layer of security considerations wrapped around the overall solution also must be accounted for. The Health Insurance Portability and Accountability Act (HIPAA) requires encryption of all data in motion and at rest to meet MHS requirements, and such encryption could be difficult to manage. These are some of the technical challenges that needed to be considered in the implementation of the solution.

To highlight the uniqueness of the concept and provide a reference point, it is helpful to compare the solution to other types of telehealth initiatives. In general, telehealth programs tend to focus on leveraging limited clinical specialist resources. By using technology to remove barriers of distance and/or time to bring the patients and physician virtually together, the remote clinician can observe and detect patient issues and make diagnostic or treatment decisions. Tele-ICU, Virtual Mental Health, and Teleradiology are good examples of these types of telehealth programs. The underlying motivation is driven by the need to leverage the scarce clinical resource—the clinical specialist—over a larger number of patients.

Although the CCC solution has most of the same components of these types of telehealth programs, there is a key difference. With the CCC solution, HMs are able to execute care algorithms safely while not deployed, keeping their skill levels at a much improved state of readiness. What makes this application unique is that the focus is on empowering the remote health care staff member—the HM—as a first priority versus leveraging the specialist skills of the remote clinician. This not only increases the resilience and readiness of the medical force but also has a positive effect on creating a more resilient, medically ready force by decreasing time away from training and other vital activities. With the proof-of-concept technology implemented for an initial set of algorithms and a system that accommodates both a mobile HM and a mobile LIP, there are significant expansion opportunities for increasing the care pathways using existing resources. Although there is fruitful opportunity to expand the program in this manner, the full potential of the technology is even more expansive.

In the last 5 years, the face of telehealth has changed dramatically as a result of the advent of value-based care payment models, improvements in technology, consumer demand for convenience, and promises of lower cost. Many vendors are trying to expand their telehealth presence. Kaiser clearly embraces the concept, conducting more than 52% of patient encounters via virtual visits.[6] With this momentum in adoption of the concept, virtual visits are more common and direct physician-to-patient virtual interactions are occurring frequently. At the same time, remote patient monitoring and connected health devices have increased the information that can be delivered to a remote clinician, leading to remote patient monitoring applications for chronic disease management and more than 300,000 health applications.[7] Many of these apps are accompanied by connected

Table 1. CCC risk assessment

Category	Hazard	Initial Risk Assessment	Mitigation	Revised Risk Assessment
Manpower				
1	Potential misdiagnosis/sentinel event caused by providers supervising more than one site	Moderate	One provider supervising per location	Minimal
2	Overburdening of commands to conduct the additional duties with limited manning	Moderate	Adjust manning to account for additional requirements	Minimal
Leadership				
1	Potential for the program to dissolve once DHA merger occurs	Moderate	Ensure the program falls under the construct of the Readiness Training Command and will not be accounted for by the military treatment facility	Minimal
2	Potential for senior personnel to pressure junior HMs into treating out-of-scope conditions with no forceful backup from senior providers on-site	Moderate	1. Ensure policies are printed and prominently displayed on-site 2. Develop alternative design to include provider on-site	Minimal
3	Potential for program failure from having a one-size-fits-all approach	High	Develop more than one option so that commands can pick what works best for them	Moderate
Training				
1	Loss of training value to the HM with the use of virtual technology	High	Provider on-site full time or part time will be able to conduct hands-on training to reinforce skills of HMs	Moderate
2	Potential for misdiagnosis/sentinel event caused by lack of clinical acumen of HMs compounded by inability of provider to conduct full assessment through virtual means	High	Utilization of provider on-site either full time or part time	Moderate
Facilities				
1	Loss of life, permanent disability, or partial disability caused by the lack of equipment to support BLS protocols	High	Update equipment list to support BLS protocols	Moderate
Budget				
1	Failure of the program due to competing budget requirements	Moderate	Provide commands alternative options that do not solely rely on virtual health	Minimal
2	Incurring associated costs of maintaining equipment	Moderate	Provide commands alternative options that do not solely rely on virtual health	Minimal
Technology				
1	Inability to execute the program in areas with limited or no connectivity	Moderate	Provide commands alternative options that do not solely rely on virtual technology	Minimal
2	Patient safety in the event that technology fails	High	1. If a singular event (i.e., network outage), mission would halt until corrected 2. Provide commands alternative options that do not solely rely on virtual technology	Minimal
3	Delay in program start-up due to complex local procurement procedures	Moderate	Create a standardized process at the local level and share lessons learned in the playbook	Minimal

health devices, and increasingly devices with artificial intelligence, to assist the patient in self-care or to asynchronously alert remote clinicians of potential issues.

ASSESSING/MITIGATING RISK

The team performed an initial risk assessment (Table 1) to proactively understand where it should develop mitigation strategies. The risks outlined in Table 1, as well as the strategies for mitigation, were communicated at all levels of BUMED and the CCC locations. The APL team focused on the risks associated with data collection and analysis as well as technology integration. For future implementation, APL recommended the following best practices:

- **Practice data transparency with stakeholders.** In the weekly working group meeting, all active team members were updated on metrics captured at each site. The recurring push of data provided a basis of comparison for each of the clinics, and through repetition, it helped refine the metrics of interest and verified quality data entry. Additionally, the multilevel engagement aided with the overall sustainment because the entire working group became familiar with every metric, how it is calculated, and how it can be used to inform decision-making. APL's role was to support the working group by pulling data from each of the active sites, analyzing the data, presenting the results to the team, and helping to refine any system requirements based on that information.
- **Plan for long lead times for IT equipment acquisition.** The technology used for virtual reach-back is integral to the program's success. Because this system had never been purchased by the Navy, several acquisition obstacles had to be overcome before the Navy could receive equipment. The first units did not arrive at Naval Hospital Pensacola until 9 months after the funding was available to purchase the equipment. Contracting processes at each command created variation in the initial orders, so standardization of the equipment and of the process to procure it is critical to long-term success of the program.
- **Implement a robust data tracker with well-defined version control.** For the concept to be measured, new data that could not be extracted from any of the existing clinical systems needed to be captured. To supplement the existing systems, a third-party data tracker was developed. As the stakeholder requirements changed, the data tracker was iteratively updated.

Over time, version control became an obstacle because the tracker was being stored locally at each of the three implementation sites. To keep data consistent, several mechanisms needed to be built into the system and additional training was necessary for the system users.

EXPANSION AND FUTURE STATE

Based on the success of the concept at the initial sites, and at the recommendation of the Navy Surgeon General, BUMED leadership is seeking input to expand the CCC program to additional geographic locations. Thanks to the resilient and adaptable nature of the program's design, lessons learned through trial and error can be applied to identify impactful locations and expand the scope of practice to serve the active-duty service member patient population in new locations.

The analytic hierarchy process (AHP), a multifactorial tool aiding in complex decision-making, was used to determine future CCC sites. AHP allows the user to weigh objective and subjective components of a decision through a series of pairwise comparisons of factors important to the decision; in this case, the factors were overall encounters, eligible encounters, population types, and staffing mix. Using a five-point scale, a pairwise comparison is made to determine the relative importance of one criterion to another (Fig. 6).

A matrix of these values is then used to calculate numeric weights (w_a) for each comparison. After normalization (X_n), criterion weights are applied to a weighted score equation, which provides a rank of each potential site based on the initial factors (Eqs. 1 and 2).

For each factor X,

$$X_n = (X - X_{min})/(X_{max} - X_{min}); \tag{1}$$

$$\text{weighted score} = \sum_{1}^{a} (w_a * X_{n_a}). \tag{2}$$

Each site receives a final weighted score based on relative importance, forming a mathematical basis for choosing the next sites (Table 2). This approach to assess

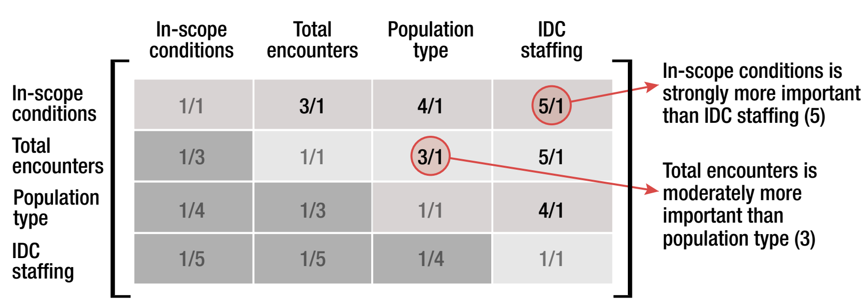

Figure 6. Pairwise comparison of factors.

Table 2. Final weight scores

Alternatives	AHP Ranking
Naval Medical Center Camp Lejeune	13.4
Naval Branch Health Clinic (NBHC) Great Lakes	12.4
NBHC Naval Station San Diego	10.8
Naval Health Clinic (NHC) Cherry Point	10.6
Branch Medical Clinic (BMC) Marine Corps Air Station (MCAS) Miramar	8.0
BMC Marine Corps Base (MCB) Camp Pendleton	6.7
Naval Hospital (NH) Okinawa	5.9
NH Jacksonville	5.6
BMC John H. Bradley Branch Health Clinic (Officer Candidate School) Brown Field	5.3
BMC MCAS Kaneohe Bay	4.3
NBHC Bancroft Hall	4.3
BMC MCB San Onofre	3.9
NBHC The Basic School	3.4
NBHC Port Hueneme	2.9
BMC Marine Centered Medical Home San Mateo	2.4

the population has proved to be far more robust than traditional assessments that strictly use encounter volumes as a single factor.

CONCLUSION

As the CCC program continues to expand beyond the proof-of-concept phase, its focus will shift from the current clinic-based environment to the field-based environment. This will allow all Navy commands to leverage this capability, rather than just Navy Medicine hospitals and clinics. Using developments in connected health, we can envision powerful technology enabling the HM to better care for warfighters in the field, even when a remote physician may not be available. The level of resilience created would substantially strengthen force capabilities and fulfill the need to operate for increasing periods without access to higher-level providers. Further advances in medical devices will provide increasingly continuous streams of data from the warfighter to diagnose problems and inform the HM of treatments. With this envisioned future, data analytics, resource modeling, and technology integration will remain key components in this health care system.

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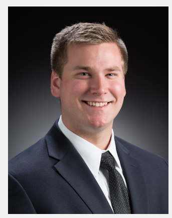

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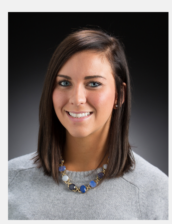

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