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Designing a critical care solution using in-person and telemedicine approaches in the US-Mexico border area during COVID-19

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ABSTRACT

Background: UC San Diego Health System (UCSDHS) is the largest academic medical center and integrated care network in US-Mexico border area of California contiguous to the Northern Baja region of Mexico. The COVID-19 pandemic compelled several UCSDHS and local communities to create awareness around best methods to promote regional health in this economically, socially, and politically important border area.

Purpose: To improve understanding of optimal strategies to execute critical care collaborative programs between academic and community health centers facing public health emergencies during the COVID-19 pandemic, based on the experience of UCSDHS and several community hospitals (one US, two Mexican) in the US-Mexico border region.

Methods: After taking several preparatory steps, we developed a two-phase program that included 1) in-person activities to perform needs assessments, hands-on training and education, and morale building and 2) creation of a telemedicine-based (Tele-ICU) service for direct patient management and/or educational coaching experiences.

Findings.

A clinical and educational program between academic and community border hospitals was feasible, effective, and well received.

Conclusion: We offer several policy-oriented recommendations steps for academic and community healthcare programs to build educational, collaborative partnerships to address COVID-19 and other cross-cultural, international public health emergencies.

1. Introduction

The UC San Diego Health System (UCSDHS) is an academic medical center and integrated care network in the southwest area of the United States within the US-Mexico border area where San Diego-Tijuana and El Centro-Mexicali are two sister-city regions. Tens of thousands of US citizens and legal residents live in Mexico for lower costs of living but are employed in the US and cross the US-Mexico border daily in these areas. Because of this intertwined relationship of communities on both sides of the border from social, economic, and political standpoints, strategies to promote public health in the US-Mexico border area are essential [1].

In March 2020, cases of COVID-19 escalated in southern California and the Baja region of Mexico. On the US side of the border (San Diego

Abbreviations: UCSDHS, University of California San Diego Health System, San Diego, CA; ECRMC, El Centro Regional Medical Center, El Centro, CA; HGT, Hospital General de Tijuana (Tijuana General Hospital), Tijuana, Mexico; HGM, Hospital General de Mexicali (Mexicali General Hospital), Mexicali, Mexico; ICU, Intensive Care Unit; ROI, Returns on investment; Tele-ICU, Telemedicine in the Intensive Care Unit.

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and Imperial counties), local community hospitals, such as El Centro Regional Medical Center (ECRMC), were filled by US citizens crossing the border from homes in Mexico to seek health care in the US. On the Mexican side of the border, local demand for healthcare exceeded supply of equipment and personnel. A cascade of consequences occurred where Mexican hospitals looked to US border hospitals for assistance, and US border hospitals looked to other US hospitals. Furthermore, public health projections indicated increasing COVID-19 case rates into mid-2020, as US expatriate populations (~200,000 in greater Tijuana area and ~300,000 in Mexicali) sought care both locally in Mexico and across the border in the US. A collaborative program between UCSDHS and Mexican hospitals was necessary especially given the geographic proximity (see Fig. 1).

1.1. Devising an action plan in critical care across international border areas

While academic health centers have traditionally focused on specialized clinical care, teaching, and research, suboptimal alignment with community health practice [2,3] has encouraged action, particularly during the COVID-19 pandemic. In this spirit, UCSDHS proactively approached border region colleagues to build solutions early in the pandemic.

In April 2020, the Baja California Secretary of Health contacted the President of Cruz Roja de Tijuana (Red Cross) for assistance from the San Diego region. The Secretary requested that UCSDHS provide support to the intensive care unit (ICU) at Hospital General de Tijuana (HGT) (Tijuana, MX) as 50+ % of the physician workforce was furloughed due to active or higher risk of serious COVID-19 infection. Several weeks into the UCSDHS effort in Tijuana, Hospital General de Mexicali (HGM) (Mexicali, MX) approached UCSDHS for similar assistance.

UCSDHS took quick steps to develop sustainable solutions to the region. First, a UCSDHS critical care team made on-site visits to each hospital and provided early assessment and planning. Second, we created a customized telemedicine-based critical care solution ("Tele-ICU") for the border hospitals: direct patient management in the US-located hospital (ECRMC) and a case-conference-styled, educational Tele-ICU platform in the Mexican hospitals (HGT, HGM).

1.2. Importance of this document

While implementation and team science-based approaches are needed to achieve quality improvement in critical care settings,[4–7] including relations-building between academic medical centers and community ICUs,[8] there is scant guidance around urgently designing and launching multi-modality critical care initiatives in cross-border contexts. Our experience particularly applies to other health centers in the US-Mexico border area dealing with COVID-19, but academic centers and community sites internationally would benefit from updated approaches to the utilizing and integrating in-person and telemedicine services in critical care, especially in any cross-cultural (e.g. geographic, ethnic, economic) context.

This document aims to improve understanding and provide guidance for developing and implementing critical care collaborative programs between academic and community hospitals. Our recommendations are based on preparatory and implementation-based experiences through July 2020 as we enacted a hybrid in-person/Tele-ICU service to address critical care needs of several US-Mexico border hospitals – one U.S. hospital (ECRMC), located in El Centro, CA, and two municipal hospitals in Mexico, located in Tijuana, MX (HGT) and in Mexicali, MX (HGM).

1.3. Preparatory steps prior to intervention

1. **Formal invitations were requested as a first step towards multi-national collaborations**. As our physicians and nurses did not possess professional licensure nor malpractice insurance coverage in Mexico, we provided onsite and Tele-ICU services in an advisory capacity only. In HGT/HGM, we received official letters and support from the Baja Health Secretary, Hospital Directors, Chiefs of Staff, and Medical Education Director, utilizing bilingual leaders to optimize relationships and understand Mexican bureaucratic structures that differed from US hospital counterparts.
2. **A response team was created quickly via decisive executive leadership**. UCSDHS senior executives rapidly created a new governance structure ("Baja COVID Support Steering Committee" and subcommittees) that devised, organized, and executed all aspects of the new program, including: solicitation and coordination of parties within and outside UCSDHS; recruitment and delegation of

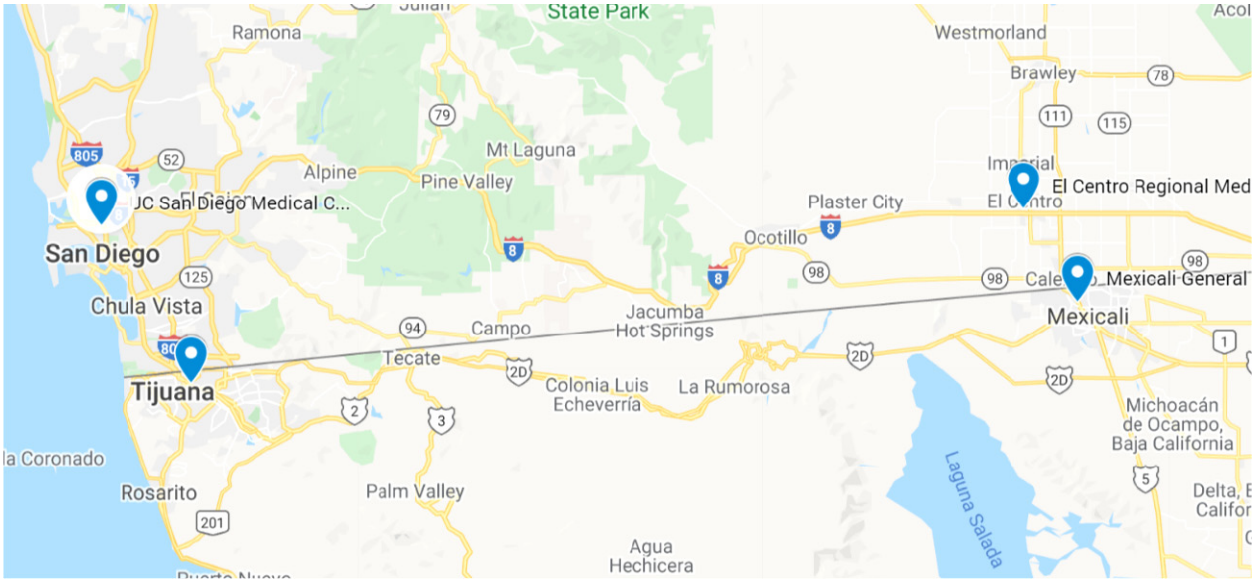

Fig. 1. Location of El Centro Regional Medical Center (El Centro, CA), Tijuana General Hospital (Tijuana, MX), and Mexicali General Hospital (Mexicali, MX), in relation to US-Mexico border and UCSDHS, located in San Diego, CA.

roles and responsibilities; facilitation of team logistics (from creation of schedules to organizing daily international travel to and from hospital sites across the border); aggregation and dissemination of information to various entities internal and external to UCSDHS.

3. **Early needs-based assessment discussions defined specific practical value proposition(s)**. Focus centered on augmenting and extending existing services and away from competing with local providers. "Pull"[4] approaches were emphasized, in which frontline providers and consumers are approached directly for solutions ("push" approaches are characterized by administrative directives driven "top-down"). Given challenges validating true COVID-19 infection and fatality rates, we accepted all requests *prima facie*. Our assessment at ECRMC, an existing UCSDHS affiliate for non-ICU clinical services, had completed before formal Tele-ICU request. At HGT/HGM, onsite personnel (i.e. insufficient numbers of intensivists, nurses) and equipment (i.e. pumps, medications, high-flow oxygen systems, ventilators) were lacking, despite recruitment efforts of general medical(non-intensivist) physicians from around Mexico.
4. **Contracts and agreements were executed before formal involvement**. UCSDHS first verified educational agreements between UCSDHS and University of Tijuana. Financial constraints of HGT/HGM during a humanitarian crisis required UCSDHS providers to engage as volunteers, while we created a novel ECRMC clinical service agreement for critical care detailing financial, operational, and clinical returns on investment (ROI) based on fair market value, areas for future growth, and regular performance reviews (see below).
5. **Medico-legal protection was ensured**. Prior UCSDHS work elsewhere within Mexico suggested that US providers act as consultants/educators alongside Mexican physicians (i.e. no direct order-writing/documentation) in HGT/HGM, per signed Memorandum of Understanding. In contrast, ECRMC Tele-ICU handled all aspects of direct patient care.
6. **The impact of local politics, media, and public perception was anticipated**. Given national attention of HGT/HGM program launches,[9] UCSDHS engaged its media relations department immediately, minimizing US and Mexican media misperceptions about degree, extent, and duration of the UCSDHS engagement. Formal notification and communication of plans occurred between the Mexican Consulate in San Diego, the US Consulate (Tijuana) and US embassy (Mexico City).
7. **Efforts were made to identify onsite Tele-ICU champions to assist execution**. We identified program champion(s) at each hospital (from physician staff, nursing, respiratory therapy, and administration).

2. Methods

We launched a hybrid, two-phase intervention that mirrored a model used in other community-based critical care outreach programs in the UCSDHS network.

2.1. In-person approach

A formal site visit by the UCSDHS-led team addressed facility structure, equipment, supplies, safety, personnel, and volume of patients (see Supplemental Table 1). A team of one critical care physician, critical care nurses, respiratory therapist, and a certified medical interpreter attended rounds at HGT each morning, seven days a week, during a four-week period. Objectives included helping establish a foundation of knowledge and skills in basic ventilator/critical care management, including ICU algorithms and protocols (sedation, ventilator liberation, etc.) and equipment recommendations (e.g. humidification devices, ventilators, etc.). At HGM, geographic distance delayed in-person support until later (mid-July 2020). Eight UCSDHS nurses and one critical care physician provided on-site education in Mexicali for three days. At ECRMC, in-person services by UCSDHS commenced only upon departure of US Armed Forces and National Guard in July 2020.

2.2. Telemedicine approach

Our initial in-person assessment assessed gaps in infrastructure, equipment, web connectivity, supplies, coverage schedules, personnel, and technological capability for Tele-ICU. A decentralized Tele-ICU system, in which tele-providers remotely connect to patients from places of convenience (e.g. home, office, or via mobile devices) rather than from a centralized hub [10,11], was selected.

At ECRMC, the Tele-ICU program provided direct patient management in conjunction with onsite hospitalist physicians. At HGT/HGM, we initiated regular case conference-style, education-based Tele-ICU sessions. In all sites, we focused on building trust and integrating with existing rounding schedules and shift-changes to enhance involvement of the clinical teams.

We created a high quality, consistent, reproducible Tele-ICU "product" to engender immediate value upon launch through:

- Careful vetting of tele-intensivist candidates based on known performance of bedside manner, communication, evidence-based practice, openness to feedback, and collegiality. We deployed few intensivists to grow familiarity and minimize practice variations.
- Creation of standardized, consistent, and predictable tele-intensivist workflows;
- Multiple on-boarding workflow-building sessions to answer questions and share tips;
- Clear expectations for tele-intensivists: 1) detailed documentation of care plan; 2) strict adherence to evidence-based practices; 3) mandatory communication with ECRMC onsite providers via phone calls to hospitalists at the end of rounds;
- Multiple pre-launch meetings with ECRMC nurse/respiratory therapist/hospitalist physician staff to clarify details of the Tele-ICU "product" including schedules and expectations.

3. Discussion

We found that several preparatory and implementation-based strategies were necessary and feasible for UCSDHS, an academic medical center network, to assist one US and two Mexican hospitals in the US-Mexico border area with COVID-19 critical care through a hybrid program of in-person and telemedicine services (see Table 1).

As in other launches of enterprise-level telemedicine solutions, [12,13] successful execution was augured by significant pre-implementation efforts in rapid, targeted needs assessments and selection/vetting of participating providers (at all engaged hospitals). As we addressed healthcare needs across international borders, we obtained sanction from political leaders[14] prior to formal engagement. Operationally, formal UCSDHS governing bodies integrated necessary individuals and skill sets, utilizing onsite champions[15] early to facilitate necessary bureaucratic processes (e.g. obtaining official letters, contracting, scheduling), encourage participation of local providers, and promote adoption of practice recommendations. Consequently, quickly clarified value propositions led to agreements in unprecedented time (i.e. within days, despite employee furloughs and lockdowns) and a clear path to successful execution. Notably, all UCSDHS team staff (nurses, therapists, physicians and interpreters) engaged on a volunteer basis in Mexican hospitals.

Table 1
Action items for initiating a successful cross-border program to improve critical care delivery.

	Action	Objective/Rationale
Preparation	Obtain formal invitations	• Simplifies logistics (e.g. facilitating border crossings) • Avoids downstream political complications due to official sanction
	Create formal governance structure	• Establishes legitimacy of the effort • Clarifies roles and responsibilities • Recognizes efforts made by participants • Facilitates delegation of tasks
	Seek executive sponsorship	• Provides clear visibility of effort to internal and external parties (e.g. enhances institutional brand) • Establishes pathway to support "top-down" ("push") change strategies
	Perform initial needs assessment emphasizing "pull" approaches [4]	• Identifies true value proposition for intervention • Empowers front-line end-users as change agents
	Design and execute contracts before formal engagement and services	• Formally legitimizes effort to both parties • Provides validity to participants that efforts are recognized and compensated • Establishes first step towards longer sustainability
Execution	Utilize both in-person and Tele-ICU elements for assessments and interventions	• Leverages both human capital and technological resources as part of solution-building • Allows concentration on specific value and overall cost-effectiveness • Provides agility as needs evolve
	Create intervention as a standardized "product"	• Optimizes "Customer Comes First" approaches to gain early support for initiative • Creates uniform expectations and consistency to minimize doubt about program value • Emphasizes evidence-based practice and broad consensus
	Emphasize team building	• Promotes trust and collegiality for a gratifying collaborative relationship • Enhances actual use of program • Synergizes efforts to improve care delivery
	Focus on generating and sustaining ROI over time	• Provides clarity on program sustainability • Establishes roadmap for possible growth and strategic pivoting to optimize value and cost-effectiveness

3.1. Implications for policy, practice, and research

1. A standard "product" as clinical deliverable that emphasizes "customer comes first" approaches, consistent evidence-based practices, and uniform expectations positively brands in-person and telemedicine services and quickly builds trust.
2. Creating a standardized Tele-ICU "product" branded Tele-ICU drove consistency and quality. Focus on standard process was calming to ECRMC nurses and staff, as variations of onsite ICU personnel background and skill sets (e.g. hospitalist and Emergency Department (ED) physicians, federal/state Disaster Management Assistance Team members from neonatal ICU andED, etc.) made expectations unpredictable.

ECRMC Tele-ICU improved adherence to evidence-based critical care interventions of COVID-19 patients [16] (e.g. advanced ventilator management, vasopressor selection, etc.) and enhanced staff confidence in critical care plans (manuscript in submission). Furthermore, ICU staff reported increased confidence caring for *non*-COVID ICU patients (for whom the Tele-ICU service was not involved), suggesting a cross-over, "osmosis" effect. We experienced similar gains in HGT/HGM. In all three hospitals, Tele-ICU case discussions facilitated idea-sharing between UCSDHS and local hospitals, as staff felt reassured of intrinsic clinical instincts and incentivized to learn advanced skills in ventilator management (e.g. assessment of "recruitability," transpulmonary gradient), sedation, and other critical care areas. Concurrently, UCSDHS staff appreciated first-hand the strong knowledge base and experience of HGT/HGM practitioners, gaining familiarity with challenges of severe resource limitations.

3. Tele-ICU must foster team building between tele-intensivists and onsite providers.

We focused team-building efforts through pre- and post-implementation periods as much as during the initial rollout itself to build collegiality and trust. Internal meetings within the tele-intensivist group, hospitalists, nursing, and other staff occurred weekly to identify opportunities for further impact. For example, at ECRMC, when the UCSDHS team shared concerns about fluid balances in ventilated COVID-19 patients, joint tele-intensivist-nursing-pharmacy teams formed, concentrating medication infusions within days.

Periodic on-site visits served to reinforce further the already strong spirit of collaboration and morale and allowed for serendipitous meetings with local community leaders. All participants have expressed interest in maintaining a long-term relationship in support of border health issues.

4. Readiness to implement is paramount.

Partnerships were successful only once parties had deadlines to execute contractual agreements. For example, despite years of negotiations, the leadership of UCSDHS and ECRMC mobilized resources in late March 2020 and created a contract within days.

5. Programmatic focus on financial, operational, and clinical returns on investment (ROI) is crucial.

Interest in program sustainability focused attention early on creating clear returns on investment (ROI). Financially, we heavily scrutinized lean indirect/direct cost models. Operationally, Tele-ICU centered on improving key workflow drivers: hospitalist confidence in ICU care, ICU patient census, and outbound patient transfers. Clinically, Tele-ICU improved adherence to evidence-based critical care principles and lowered lengths of stay (personal observations). We provided accountability and transparency of our efforts through weekly emails and monthly performance presentations to ECRMC board meetings. Additional opportunities included submission of Tele-ICU professional fee claims and enhanced utilization of post-acute care networks.

At HGT/HGM, creating a strong ROI was challenging in our primarily advisory/educational capacity. Ongoing plans include onsite visits and mentorship of Mexican physicians at the UCSDHS campuses, trainee exchanges to foster medical learning opportunities. As cases surge, however, UCSDHS clinicians face mounting pressure regarding primary responsibilities, reducing time to devote to volunteer activities. Without alternative avenues of sustainability (e.g. philanthropy, foundation-based grants), the gains at HGT/HGM to date may fade.

Strengths include involvement of multiple health centers in an internationally important, cross-border region with highly fluid movement representative of other cross-cultural contexts. In addition, consistently high COVID-19 case numbers in these hospitals over months facilitated reliable execution of policies. Limitations were primarily due to rapid efforts to provide critical clinical services in hospitals in desperate need of assistance. Each site (HGT, HGM, and ECRMC) had unique needs, infrastructure, and historical relationships with UCSDHS that complicated unified approaches allowing adequate comparisons. Ongoing evaluations are underway with more standardized processes for more detailed, comprehensive, and valid evaluations of this initiative.

4. Conclusions

We detail preparatory and implementation-based aspects of our recent experience at UCSDHS in addressing requests of three hospitals in the US-Mexico border region of southern California and northern Baja region of Mexico for critical care support during the COVID-19 pandemic. A partnership between an academic center and resource-limited community hospitals was feasible, rapidly executable, and effective in generating clinical, operational, and educational value that is also cost-effective. Common themes that engendered success included team building, idea sharing, and adherence to evidence-based practice in critical care. Our experience serves as a blueprint for other academic and community centers looking to build collaborative partnerships to address international public health emergencies.

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CRediT authorship contribution statement

Venktesh R. Ramnath: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Linda Hill:** Conceptualization, Formal analysis, Project administration, Writing – review & editing. **Jim Schultz:** Conceptualization, Methodology, Writing – review & editing. **Jess Mandel:** Conceptualization, Data curation, Methodology, Project administration, Resources, Supervision, Writing – review & editing. **Andres Smith:** . **Stacy Holberg:** Conceptualization, Project administration, Writing – review & editing. **Lucy E. Horton:** Conceptualization, Funding acquisition, Methodology, Writing – review & editing. **Atul Malhotra:** Conceptualization, Formal analysis, Supervision, Writing – review & editing. **Lawrence S. Friedman:** Conceptualization, Project administration, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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