Development of a Prioritization Model to Compare Emergency Psychiatric Coverage Service Options

Jacqueline Sandling (✉ jsand15@alumni.stanford.edu)
  Stanford Hospital and Clinics
Kathleen Carrothers
  Stanford Health Care
David Svec
  Stanford University School of Medicine

Abstract

Background: Reducing Length of Stay (LOS) is an important way for hospitals to improve emergency department (ED) costs and outcomes. Psychiatric patients represent a challenge to reducing LOS when the scarcity of psychiatric specialists leads to longer LOS. Previous literature describes the unique solutions different hospitals have employed across the US, but does not share methods for evaluating or selecting a solution that can be applied to other hospitals.

Methods: We conducted a review of hospital ED case data, market research on psychiatry services, and interviews with hospital staff. This information, along with projected return on investment, was aggregated to create a holistic model for evaluating different service options and selecting the one with the best fit.

Results: To develop a prioritization model that identifies the one psychiatric service improving psychiatric LOS and best fitting the hospital's overall priorities and operations, our methodology identified 8 key factors that captured the overall difficulty of implementation and benefits associated with each service option.

Conclusion: The Prioritization Model created in this study was instrumental in selecting the solution for reducing LOS in a way that best meets patients' and the hospitals' needs. This model may be applied to other hospitals and service evaluations to provide a holistic review and direct comparison of opportunities.

Background

Reducing length of stay (LOS) is an important way for hospitals to improve cost efficiency and health outcomes in their emergency department (ED). One challenge occurs when a patient presents with mental health concerns but there is no specialist to lead the diagnosis, treatment, and disposition [1]. The extended waiting time between the patient's arrival and treatment is known as psychiatric boarding. Psychiatric involuntary holds (IPHs), which are initiated when a person is considered a danger to themselves or others, contribute to boarding when availability at psychiatric facilities is limited. All states have emergency hold laws of some type although the specifications of enactment vary [2]. In California, IPHs last up to 72 hours [3–4]. Boarding in the ED creates several problems: increased stress and delayed mental health treatment for psychiatric patients; worsened ED overcrowding; delayed treatment for other ED patients; and loss of ED revenue [5].

Previous literature outlines efforts to leverage telepsychiatry within the ED to decrease length of stay [5–13]. Two nationally representative surveys found that 1 in 5 EDs used telepsychiatry instead of an in-person psychiatrist. Most EDs using telepsychiatry reported telepsychiatry was the only emergency psychiatry service available to them, suggesting it plays a critical role in access to mental health services [6]. As noted by Hau et al. advances in technology have incorporated videoconferencing into telemedicine [14], allowing more intimacy between the provider and patient. A randomized clinical trial in 2006 demonstrated that telepsychiatry via videoconferencing had equivalent efficacy to in-person care [15], and a review from 2013 confirmed that finding [16]. Furthermore, a review by Bokolo found that telemedicine plays a critical role in enabling access to psychiatric services without increasing risk of contracting or spreading COVID-19 [17].

Despite the wealth of literature focused on how telepsychiatry services have been implemented, only some address financial costs [6–9, 12, 18–19]. The available models focus primarily on realized costs post implementation without guidance for estimating costs prior to implementation [7, 19]. In addition, there is a scarcity of research defining the attributes and outcomes of a successful telehealth business model. None propose an actionable method for selecting a psychiatry service partner based on financial concerns or other priorities [20–23, 24]. Hospitals implementing an emergency telepsychiatry service have limited resources available to guide their decision-making process.

This paper will propose a specific methodology for evaluating emergency psychiatry service options and identifying which aligns best with the hospital's needs by translating each option's unique features into two indices that allow for direct comparisons. This paper will also provide a specific methodology for calculating the return on investment (ROI) of emergency psychiatry service options. Both methodologies may be applied to other hospitals with unique patient demographics and operational workflows.

Methods

Reducing length of stay (LOS) is an important way for hospitals to improve cost efficiency and health outcomes in their emergency department (ED). One challenge occurs when a patient presents with mental health concerns but there is no specialist to lead the diagnosis, treatment, and disposition [1]. The extended waiting time between the patient's arrival and treatment is known as psychiatric boarding. Psychiatric involuntary holds (IPHs), which are initiated when a person is considered a danger to themselves or others, contribute to boarding when availability at psychiatric facilities is limited. All states have emergency hold laws of some type although the specifications of enactment vary [2]. In California, IPHs last up to 72 hours [3–4]. Boarding in the ED creates several problems: increased stress and delayed mental health treatment for psychiatric patients; worsened ED overcrowding; delayed treatment for other ED patients; and loss of ED revenue [5].

Previous literature outlines efforts to leverage telepsychiatry within the ED to decrease length of stay [5–13]. Two nationally representative surveys found that 1 in 5 EDs used telepsychiatry instead of an in-person psychiatrist. Most EDs using telepsychiatry reported telepsychiatry was the only emergency psychiatry service available to them, suggesting it plays a critical role in access to mental health services [6]. As noted by Hau et al. advances in technology have incorporated videoconferencing into telemedicine [14], allowing more intimacy between the provider and patient. A randomized clinical trial in 2006 demonstrated that telepsychiatry via videoconferencing had equivalent efficacy to in-person care [15], and a review from 2013 confirmed that finding [16]. Furthermore, a review by Bokolo found that telemedicine plays a critical role in enabling access to psychiatric services without increasing risk of contracting or spreading COVID-19 [17].

Despite the wealth of literature focused on how telepsychiatry services have been implemented, only some address financial costs [6–9, 12, 18–19]. The available models focus primarily on realized costs post implementation without guidance for estimating costs prior to implementation [7, 19]. In addition, there is a scarcity of research defining the attributes and outcomes of a successful telehealth business model. None propose an actionable method for selecting a psychiatry service partner based on financial concerns or other priorities [20–23, 24]. Hospitals implementing an emergency telepsychiatry service have limited resources available to guide their decision-making process.

This paper will propose a specific methodology for evaluating emergency psychiatry service options and identifying which aligns best with the hospital's needs by translating each option's unique features into two indices that allow for direct comparisons. This paper will also provide a specific methodology for calculating the return on investment (ROI) of emergency psychiatry service options. Both methodologies may be applied to other hospitals with unique patient demographics and operational workflows.

Methods

Setting

This study took place in a community hospital's 18-bed ED. As the ED does not staff a psychiatrist or mental health expert, the ED cannot directly treat or remove IPHs, which require a psychiatrist evaluation. Social workers must coordinate a transfer to a psychiatric facility for all psychiatric holds to be evaluated and lifted. Research consent was deemed unnecessary because the project was determined by Stanford IRB panel IRB-98 not to meet the definition of human subjects research as defined in federal regulations 45 CFR 46.102 or 21 CFR 50.3.

Qualitative Data Collection

This qualitative study used 2 rounds of semi-structured interviews to identify causes for psychiatric boarding. The first round was conducted with ED staff who treat psychiatric patients directly. The second round was with administrators who manage ED projects and finances. These interviews also served as an initial assessment of all staff's motivational readiness to support a new program [25].

A qualitative thematic analysis of these interviews identified main barriers to treatment and opportunities for hospital operations to be adjusted to address these barriers.

Quantitative Data Analysis

ED case data was analyzed to quantify psychiatric patients' needs and the opportunity to improve their care. ED case volume was collected from Jan 1, 2019 to Feb 29, 2020. A psychiatric ED case was defined as a case that began with an IPH, ended with a transfer to a psychiatric facility, or both. LOS is the time between the patient's arrival and discharge, and psychiatric LOS improvement means shortening it to the mean LOS for non-psychiatric cases. As seen in Table 1, the opportunity for improvement was sizable: mean psychiatric cases' LOS was 8.5 hours longer than non-psychiatric cases'. The ED's schedule was categorized into peak and non-peak hours. The greatest volumes of patients arrive during peak hours, experiencing longer lengths of stay and greater risk of leaving without being seen (LWBS) by a provider.

Table 1 Length of Stay (LOS) for ED Cases

Length of stay summary statistics are shown by ED case type for all times of day and for peak time (10am – 8pm)

	Psychiatric Cases	Non-Psychiatric Cases	All Cases
All Time	(N = 875)	(N = 41001)	(N = 41876)
Mean	11.98	3.44	3.62
Median	8.75	3.07	3.12
Standard Deviation	9.92	2.14	2.84
Peak Hours (10am-8pm)	(N = 498)	(N = 25224)	(N = 25722)
Mean	12.69	3.65	3.82
Median	8.71	3.32	3.37
Standard Deviation	10.87	2.14	2.88

A "clearance rate" is the percent of all patients arriving in the ED with an IPH that are removed post-evaluation. At the time of intervention, the IPH clearance rate was 0% due to lack of psychiatric providers on staff. Data from two telepsychiatry programs suggested that access to psychiatric care in the ED could raise clearance rates to 25–80% [5, 8, 26]. This hospital analysis used the IPH clearance rate estimated by its social worker team, 50%.

Developing the Evaluation Framework

Quantitative data was used to develop a framework for evaluating service options. Evaluation required both calculating expected costs to ensure affordability and assessing overall fit: "how well does the service option solve our problem?" The method for calculating expected ROI mirrors those that other studies used for post-implementation ROI calculations [7, 19]. This alignment allows for actionable pre-post analyses. This study incorporated the generalized financial considerations suggested by previous literature, such as costs for purchasing technological devices [6–9, 12, 18–19].

ROI was projected for a 5-year time horizon. Since ROI relied on case volume during peak hours, it was calculated for 3 scenarios with different ED case volumes: low, expected, and high volume. Because ROI also depended on the IPH clearance rate, sensitivity analyses were conducted to assess changes in both factors: ED peak capacity and improvement in LOS due to removing IPHs.

Important features for an emergency psychiatry service other than ROI include the ability to meet patients' needs, patient centeredness, smooth processes and operations, strategic alignment, and integration of care [24–25, 27]. A "Prioritization Model" was created to categorize all features as either a "benefit" or "implementation difficulty" and then score each psychiatry service option on how well it aligned with the community hospital's needs. The prioritization model builds upon these categories outlined by previous literature [24–25, 27] and the results from the qualitative analysis. This model allows for categories to be weighted to reflect how important each feature is: for instance, a category with a weight of 2 is twice as important as another category with a weight of 1. The hospital created 2 models with different prioritization weights: one optimizing for financial performance overall; and one optimizing for partnership and community engagement.

Search for Psychiatry Services

Telepsychiatry vendors and market solutions were found by two mechanisms. First, an online search was conducted using these search terms:

"telepsychiatry" OR "psychiatry" OR "telemedicine psychiatry" AND "emergency" OR "hospital" OR "emergency consultation" OR "acute" AND "service" OR "vendor" OR "company"

Searches were repeated with "Bay Area" or "California" or "East Bay". Second, opportunities within the hospital network were sought out.

Results

Qualitative Themes

There were 11 first round interview participants including ED Administrative and Medical Directors; Social Services Director and staff; 3 Hospitalists; and Nursing Officers. The second round of interviews was conducted with 6 administrators from Compliance, Finance, Project Management, and Business Development teams. All ED staff and administrators eager to explore service solutions to address psychiatric boarding.

Four thematic domains emerged as seen in Table 2: the causes of psychiatric boarding, and the impacts that boarding has on patients, providers, and the hospital overall.

Table 2 Causes of psychiatric patient boarding and the negative impacts from the perspective of ED and administrative staff

Themes from qualitative interviews were grouped into 4 main domains

Domain 1: Causes of Boarding
● Inability to remove involuntary psychiatric holds in the ED when appropriate
● Low vacancy rates at inpatient psychiatric facilities
● Inability to consult with a psychiatrist to triage patients' needs according to urgency
Domain 2: Impact on Patients
● Psychiatric patients receive delayed care
● Other ED patients receive delayed care
● Negative impact overall patient experience and satisfaction
Domain 3: Impact on ED staff
● Frustration from inability to provide needed psychiatric care
● More attention and bandwidth required to monitor psychiatric patients while boarded
Domain 4: Impact on Hospital
● Loss of revenue due unavailability of ED beds
● Negative impact on reputation within the community
● Difficulty attaining Joint Commission accreditation

Although low vacancy rates at other facilities (Domain 1) were beyond the community hospital's direct control, the other causes were within the community hospital's control and could be solved with reliable access to a psychiatrist in the ED.

ROI Model

In the ROI model the expected profit comprises two sources: direct costs that are currently incurred and will be avoided post implementation; and new revenue from treating ED patients who would have LWBS. Two direct costs associated with delays in psychiatric care (Domain 2) were identified: sitters and funded transportation to psychiatric facilities for uninsured patients. These costs were multiplied by the psychiatric case volume and expected LOS improvement rate

(50%) to represent direct cost savings. New revenue from treating patients with the time saved from psychiatric cases was calculated as the average contribution margin per ED case multiplied by the number of additional patients that could be treated. This revenue captured the financial impact to the hospital (Domain 4).

The financial investment required for each service option was estimated using pricing structures supplied by service options. Each pricing structure comprised 2 fee types: one-time implementation fees including purchase of equipment; and monthly fees for ongoing staff and technical support.

A breakdown of savings and costs included in calculating ROI is found in Fig. 1. The ROI was considered as one factor in the Prioritization Model.

Prioritization Model

Inputs and themes from the two rounds of interviews were used to identify 8 different categories important to have in any psychiatry service: five categories of benefits and three categories representing implementation difficulty. For all categories, higher scores were favorable. As seen in Table 3, each category was further broken down into more specific components that could be directly answered with either a number or Yes/No.

Components with percent values were converted into quintiles, with negative percent values assigned a score of 0. For example, an ROI of 65% was given a score of 4. Other numeric values were converted into a percent of the maximum component value and assigned a quintile score. For example, if the greatest LOS improvement across all service options was 4.6 hours, then the service option offering an improvement of 1.4 hours would be assigned a score of 2.

For Yes/No questions, Yes was assigned a score of 3 and No was assigned a score of 0.

Table 3 Components of Prioritization Model Categories

Questions used in the prioritization model to evaluate the strengths and weaknesses of each psychiatric service option

Criteria — Implementation Difficulty
Initial Implementation
How many days will it take for the service to be implemented?
How much money will the hospital have to spend up front on implementation?
Logistics
Is the partner within the health care organization network?
Will the service provide support for ongoing training, IT concerns, and general questions?
Will the hospital be able to avoid changing its operational systems significantly including electronic medical records and full time employee allocation to add this service?
Financial Costs
How expensive is the program over 5 years?
Does the service include revenue management?
Criteria — Benefit
Meets Patient Needs
How many psychiatric patients can have a psychiatric consult scheduled?
What is the average improvement in the time to first psych consult?
How many Left Without Being Seen (LWBS) patients could be treated with the time we save?
How insensitive is the volume of LWBS opportunities to ED peak time capacity and the LOS improvement rate?
Is the service in person or telemedicine?
Is the service certified or accredited by a 3rd party such as the Joint Commission? Is a certain level of clinical quality ensured?
Meets Staff Needs
Do ED staff feel confident in the psychiatric consult service's outcomes?
Do ED staff feel confident that the service can integrate into current operations/workflows smoothly?
Do ED staff believe the service will improve employee satisfaction?
Partnership Viability
Is the solution within the network?
Is the solution embedded in the community?
Future Opportunities
Does the partner offer training and fellowship opportunities for current medical trainees? Are there Leadership and Directorship opportunities for current professionals?
Financial Viability
How insensitive is the ROI to ED peak time capacity and the LOS improvement rate?
What is the ROI after 1 year?
What is the ROI after 5 years?

Component scores were averaged to calculate a category score. Each category score was then multiplied by weights determined by the hospital. Weights (0–2) were assigned to each category based on perceived importance. The weighted scores were then summed to create an overall "Benefit" score and "Implementation Difficulty" score per service option. Since a higher score is better across benefits and implementation difficulty, these two can be summed together to find the one service option with the highest total score, indicating best fit.

The relative weights used by the hospital in this study are shown in Table 4. This hospital created two prioritization models: a "Financial" model where positive return on investment was considered just as important as meeting patient needs; and a "Community Engagement" model where embedment in the community and health care network were considered just as important as meeting patient needs.

The ability to change category weights allows for generalizability: if another hospital is evaluating programs that improve staff recruitment and retention, for instance, that hospital can weigh "meets staff needs" more heavily in their own model.

Table 4 Category Weights Used for Each Prioritization Model

An example of weights applied to categories in each model to represent different versions of one hospital's priorities

	Category	Financial Model	Community Engagement Model
Benefits	Meets Patient Needs	2	2
	Meets Staff Needs	0*	0*
	Partnership Viability	1	2
	Future Opportunities	1	2
	Revenue	2	1
Implementation Difficulty	Initial Implementation	0*	1
	Logistics	0**	1.5
	Financial Cost	2	1
indicates categories where all service options had the same score.			
** *indicates categories that were not priorities for the hospital but are important for hospitals to consider generally.*			

Putting it All Together: Selecting a Service Option

This study identified 10 possible service options. Four were within the network and all offered telepsychiatry. Six services provided revenue management, and 8 services offered reconciliation of psychiatrist professional fees.

Community Engagement and Financial Model scores are presented in Table 5 for each of the 10 service options explored.

The average benefit score in the Community Engagement Model was 11.8 (SD = 2.8) and the average implementation difficulty score was 5.7 (SD = 1.3). Option J achieved both the highest benefit score of 16.0 and the highest implementation difficulty score of 7.0, making Option J the preferred partner in this model.

The average benefit score in the Financial Model was 10.8 (SD = 3.1) and the average implementation difficulty score was 4.7 (SD = 2.5). Option A received the highest benefit score in this model (16.2), while Option B achieved the highest sum score of 20.0 (benefit = 14.0; implementation difficulty = 6.0). Both A and B ranked high in prioritization using the Financial Model.

Table 5 Weighted Benefit and Implementation Difficulty Scores per Service for Community Engagement Model and Financial Model

Outcomes for each psychiatric service option evaluated using the 2 prioritization models

Service	Tele- psychiatry or In-Person?	Community Engagement Model			Financial Model		
		Benefit	Implemen- tation Difficulty	Total Score	Benefit	Implemen- tation Difficulty	Total Score
Option A	Tele	14.0	4.5	18.5	16.2	3.0	19.2
Option B	Tele	10.7	7.0	17.7	14.0	6.0	20.0
Option C	Tele	9.7	5.5	15.2	12.0	5.0	17.0
Option D	Tele	9.7	5.0	14.7	12.0	2.0	14.0
Option E*	Tele	14.7	6.0	20.7	10.8	6.0	16.8
Option F	Tele	8.0	3.0	11.0	8.7	0.0	8.7
Option G*	Tele	14.3	5.5	19.8	10.2	5.0	15.2
Option H*	Tele	12.0	7.0	19.0	7.5	8.0	15.5
Option I	Both	8.7	6.0	14.7	5.7	4.0	9.7
Option J*	Both	16.0	7.0	23.0	11.0	8.0	19.0
Range of Possible Scores		0–35.0	0–17.5	0–52.5	0–30.0	0–10.0	0–40.0
Standard Deviation		2.8	1.3	3.5	3.1	2.5	3.8
indicates in-network status.							

Table 6
Count of ED Discharge Locations for Involuntary Psychiatric Hold Cases

	N of IPH Cases	% of IPH Cases	Mean LOS
Transfer to Psychiatric Facility	560	80.0%	12.7
Admit to Inpatient	55	7.9%	6.4
Discharge Home	47	6.7%	16.4
Transfer to Other Health Care Facility	30	4.3%	9.2
Other	8	1.1%	14.9
Total	700	100.0%	12.3
Tables Larger than One Page in Length			

Discussion

This study proposes a structured way of evaluating ED psychiatry service options. Few studies have proposed a generalizable method that can apply to other hospitals. One challenge previously cited is the diversity in health care settings [22, 28]. However, this study suggests a method that may be used even when costs and priorities vary, allowing for a direct comparison of options.

The ROI methodology was conservative in the following ways: first, the definition of "psychiatric case" excludes cases where LOS was unlikely to improve. Second, direct costs excluded the costs of non-sitter staff, bus tickets, and other transient costs. Third, new revenue from non-peak hour cases was not incorporated, because it is not confirmed that patients are at risk for LWBS in non-peak hours. Fourth, it was assumed that all psychiatric cases required a full evaluation to shorten their LOS. In November 2020 the County implemented a policy where a consultation with a psychiatrist would likely suffice for placing and removing IPHs. Since consultations are faster than evaluations, it is possible that even greater improvements in LOS could be captured.

The following were not quantified but are expected to improve with increased access to psychiatry and decreased psychiatric boarding: patient satisfaction; indirect costs from provider productivity and satisfaction (thematic Domain 3); ability to meet The Joint Commission standards or other quality metrics for accreditation [29]; and reputation within the community.

This study's main limitation is its single-site nature. When other sites choose to use the ROI Model and Prioritization Model, there may be additional considerations: different regulatory landscapes and opportunities within-network for example. With that in mind, the authors propose that other hospitals evaluating psychiatry ED services will still be able to substitute their own costs and priorities to select the service option best fitting their specific needs.

Conclusion

The concerns with psychiatric boarding in the ED are well documented as the impact is felt not only by psychiatric patients but also other ED patients, ED care providers, and hospital networks. Many hospitals have published their own efforts to tackle psychiatric boarding. To our knowledge, this is the first study to propose a generalizable method for evaluating multiple psychiatry service options and selecting the one best fit for the patients' and hospital's specific needs. Our model provides a methodology to improve the decision making process for choosing a new service.

Abbreviations

ED
Emergency Department
IPH
Involuntary Psychiatric Hold
LOS
Length of Stay
LWBS
Leaving Without Being Seen
ROI
Return On Investment
SD
Standard Deviation

Declarations

Ethics approval and consent to participate

Research consent was deemed unnecessary because the project was determined by Stanford IRB panel IRB-98 not to meet the definition of human subjects research as defined in federal regulations 45 CFR 46.102 or 21 CFR 50.3.

Consent for publication

Not applicable.

Availability of data and materials

Data on ED case volume from Jan 1, 2019 to Feb 29, 2020 are available from the corresponding author on reasonable request and with permission of the facility.

The pricing model data that support the findings of this study are from third party vendors but restrictions apply to the availability of these data, and so are not publicly available. A list of vendors is available from the authors upon reasonable request.

The Prioritization and ROI Models discussed in this published article are found in the supplementary files *Prioritization Model.xlsx* and *ROI Model.xlsx.*

Competing Interests

One author has invested in an outpatient ADHD startup, which does not interact with inpatient care or emergency departments. The authors declare that they have no other competing interests.

Authors' contributions

DS and KC contributed to the conceptualization of this study. All authors designed the study. JS and KC performed material preparation, data collection, and analysis. JS conducted literature searches and prepared the manuscript. DS and KC provided ongoing feedback and consultation during the manuscript preparation stages. All authors read and approved the final manuscript.

References

1. Meyer JD, McKean A, Blegen RN, Demaerschalk BM. Emergency Department Telepsychiatry Service Model for a Rural Regional Health System: The First Steps. Telemed J E Health. 2019;25:18−24. https://doi.org/10.1089/tmj.2017.0293.

2. Hedman LC, Petrila J, Fisher WH, Swanson JW, Dingman DA, Burris S. State Laws on Emergency Holds for Mental Health Stabilization. Psychiatric services. 2016;67(5):529−35. https://doi.org/10.1176/appi.ps.201500205.

3. Article 1:DetentionofMentallyDisorderedPersonsforEvaluationandTreatment[5150−5155]. (2019)CaliforniaLegislativeInformation.leginfo.legislature.ca.gov.Accessed23December2020.

4. Article 4:CertificationforIntensiveTreatment[5250−5259.3].(2015)CaliforniaLegislativeInformation.leginfo.legislature.ca.gov.Accessed23December2020.

5. Rachal J, Sparks W, Zazzaro C, Blackwell T. Highlight in Telepsychiatry and Behavioral Health Emergencies. Psychiatr Clin North Am. 2017;40:585−96. https://doi.org/10.1016/j.psc.2017.05.014.

6. Freeman RE, Boggs KM, Zachrison KS, Freid RD, Sullivan AF, Espinola JA, Camargo CA. National Study of Telepsychiatry Use in U.S. Emergency Departments. Psychiatr Serv. 2020;71:540−6. https://doi.org/10.1176/appi.ps.201900237.

7. Thomas JF, Novins DK, Hosokawa PW, Olson CA, Hunter D, Brent AS, Frunzi G, Libby AM. The Use of Telepsychiatry to Provide Cost-Efficient Care During Pediatric Mental Health Emergencies. Psychiatr Serv. 2018;69:161−8. https://doi.org/10.1176/appi.ps.201700140.

8. Hyer T, Zeller S. Behavioral Healthcare in ED Improved with Telepsychiatry. Hosp Peer Rev. 2017;42:42−4.

9. States leverage telepsychiatry. solutions to ease ED crowding, accelerate care. ED Manag. 2015;27:13−7.

10. Brantley T, Holton A(2014)TelepsychiatryinNorthCarolina:MentalHealthCareComestoYou.NorthCarolinaCenterforPublicPolicyResearch.https://www.ecu.edu/.Accessed6Dece

11. Reliford A, Adebanjo B. Use of Telepsychiatry in Pediatric Emergency Room to Decrease Length of Stay for Psychiatric Patients, Improve Resident On-Call Burden, and Reduce Factors Related to Physician Burnout. Telemed J E Health. 2019;25:828−32. https://doi.org/10.1089/tmj.2018.0124.

12. Narasimhan M, Druss BG, Hockenberry JM. Impact of a Telepsychiatry Program at Emergency Departments Statewide on the Quality, Utilization, and Costs of Mental Health Services. Psychiatr Serv. 2015;66:1167−72. https://doi.org/10.1176/appi.ps.201400122. etal(.

13. Saeed SA(2020)UsingTelepsychiatryandHealthTechnologiestoProvideEvidence-BasedCare.EastCarolinaUniversityCollegeofNursing.https://nursing.ecu.edu/.Accessed12November2020.

14. Hau YS, Kim JK, Hur J, Chang MC. How about actively using telemedicine during the COVID-19 pandemic? Journal of medical systems. 2020;44(6):108. https://doi.org/10.1007/s10916-020-01580-z.

15. De Las Cuevas C, Arredondo MT, Cabrera MF, Sulzenbacher H, Meise U(2006)Randomizedclinicaltrialoftelepsychiatrythroughvideoconferenceversusface-to-faceconventionalpsychiatrictreatment.TelemedJEHealth12(3):341−350.doi:10.1089/tmj.2006.12.341.

16. Hilty DM, Ferrer DC, Parish MB, Johnston B, Callahan EJ, Yellowlees PM. The effectiveness of telemental health: a 2013 review. Telemed J E Health. 2013;19(6):444−54. doi:10.1089/tmj.2013.0075.

17. Bokolo A. Use of Telemedicine and Virtual Care for Remote Treatment in Response to COVID-19 Pandemic. J Med Syst. 2020;44:132. https://doi.org/10.1007/s10916-020-01596-5.

18. Hilty DM, Bourgeois JA, Nesbitt TS, Hales RE. Cost issues with telepsychiatry in the United States. Int Psychiatry. 2004;1:6−8.

19. Moore M, Moreschi A, Rieger K, Vardaro M. Return on Investment Analysis of the VSN1 Telehealth Program. Major Qualifying Project Report,Worcester Polytechnic Institute; 2013.

20. Hilty DM, Williams M, Pfeffer M, Boyle J(2009)TelepsychiatryintheEmergencyDepartment:OverviewandCaseStudies.CaliforniaHealthCareFoundation.https://www.chcf.org/.Accessed9November

21. van der Goes DN, Edwardson N, Rayamajhee V, Hollis C, Hunter D (2019) An iron triangle ROI model for health care. Clinicoecon Outcomes Res 11:335−348. doi:10.2147/CEOR.S130623.

22. Augenstein J, Marks JD, Brown A(2020)EstimatingtheROIofTelehealthPrograms.ManattPhelps&PhillipsLLP.https://www.lexology.com/.Accessed25November2020.

23. Kramer GM, Shore JH, Mishkind MC, Friedl KE, Poropatich RK, Gahm GA. A standard telemental health evaluation model: the time is now. Telemed J E Health. 2012;18:309−13. doi:10.1089/tmj.2011.0149.

24. Arkwright BT, Leslie M, Light M(2019)Telehealth Finance Variables and Successful Business Models.Telehealth Medicine Today,4.https://doi.org/10.30953/tmt.v4.140.

25. Mishkind MC, Doarn CR, Bernard J, Shore JH. The use of collaboration science to define consensus outcome measures: a telemental health case study. Telemed J E Health. 2013;19:455−9. doi:10.1089/tmj.2013.0069.

26. Telepsychiatry program. eases patient crowding in the ED, expedites mental health services to patients and providers. ED Manag. 2013;25:121−4.

27. Shore JH, Mishkind MC, Bernard J. A lexicon of assessment and outcome measures for telemental health. Telemed J E Health. 2014;20:282−92. doi:10.1089/tmj.2013.0357. etal(.

28. Leach WD(2009)IfYouBillIt,TheyWillCome:ALiteratureReviewonClinicalOutcomes,Cost-Effectiveness,andReimbursementforTelemedicine.CaliforniaTelemedicineandeHealthCenter.https://www.caltrc.org/.Accessed11November2020.

29. The. "Patient Flow Standard" and the 4-Hour Recommendation.(2013)TheJointCommission.https://www.jointcommission.org.Accessed6December2020.
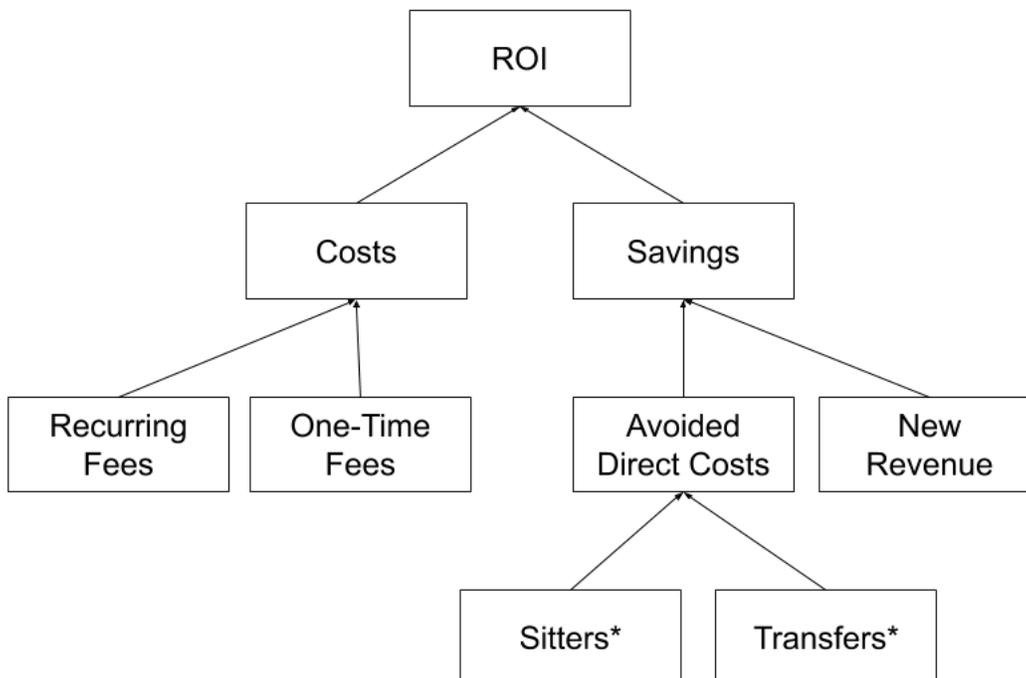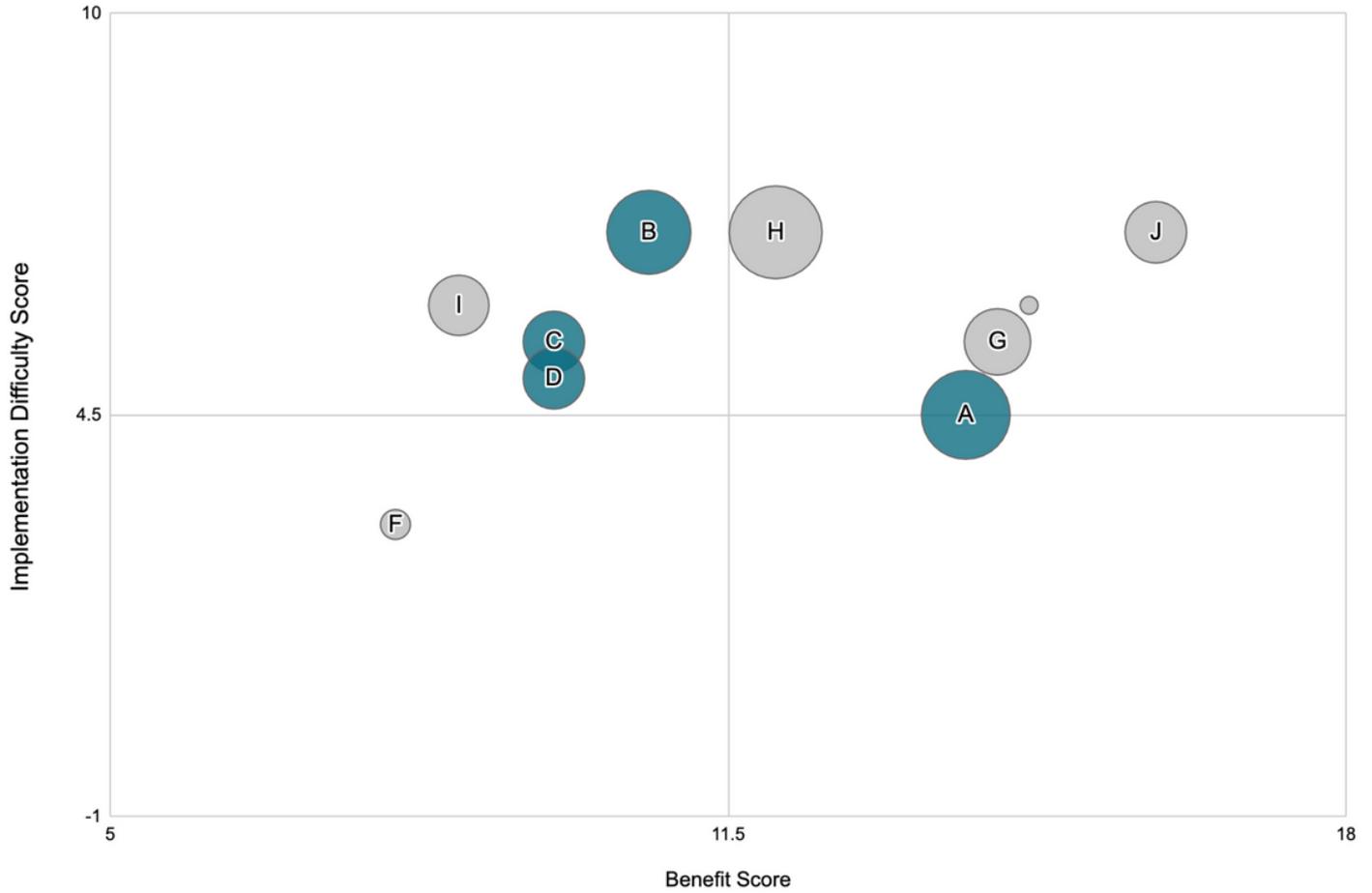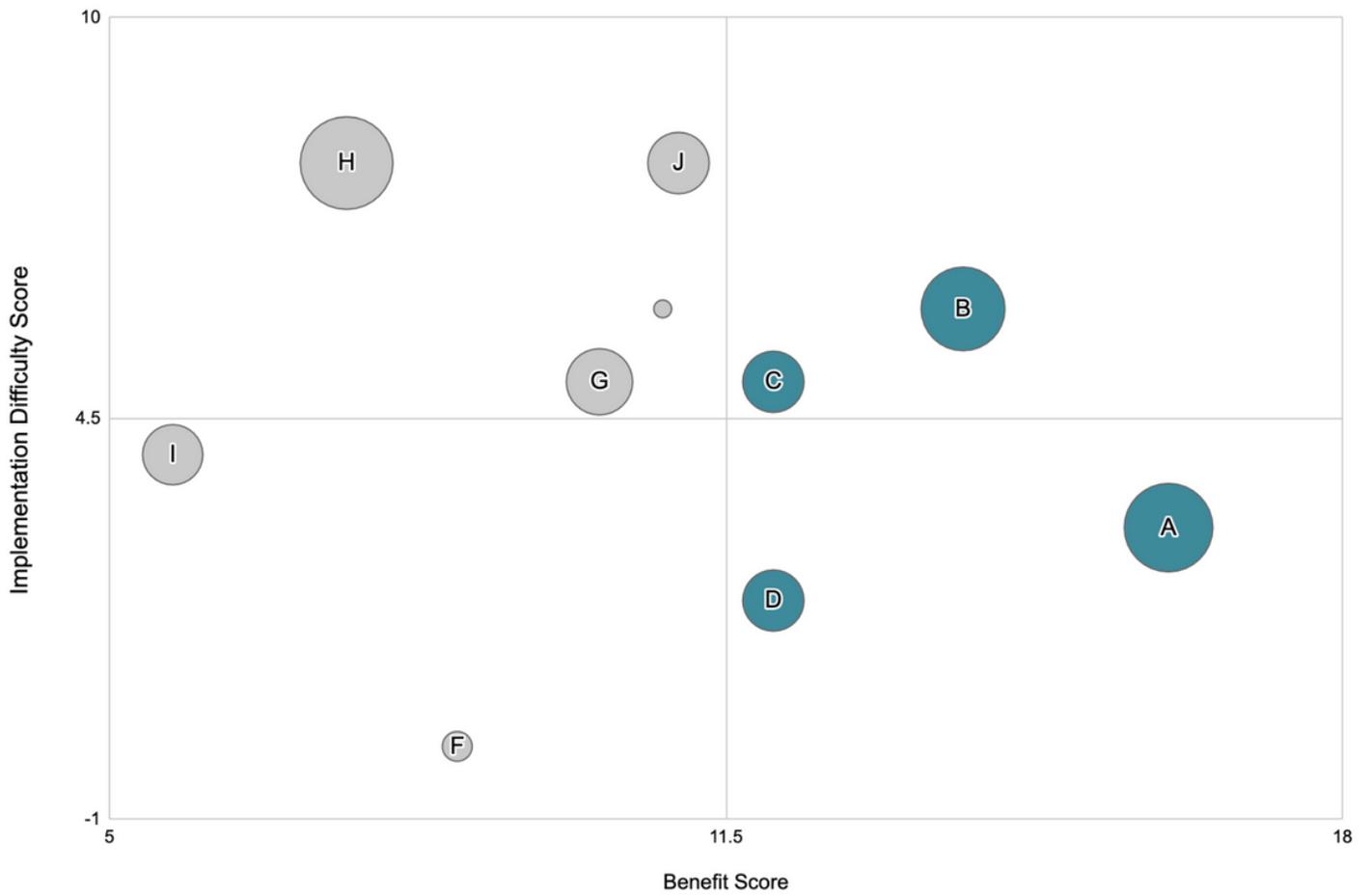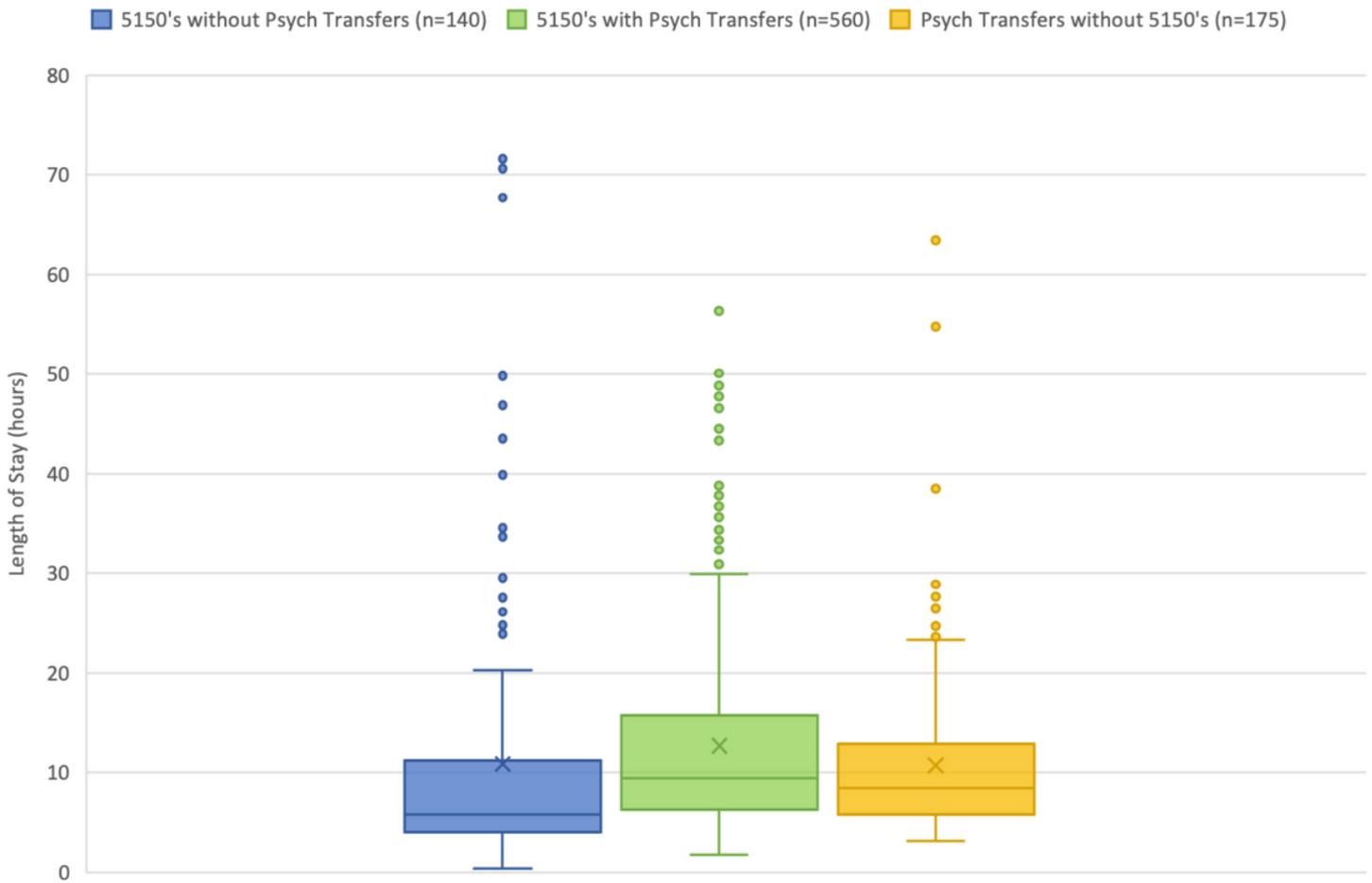
Figures

Figure 1

Sources of Costs and Savings Used to Calculate Return on Investment (ROI) This diagram shows the breakdown of financial information used to calculate projected costs and savings, and ultimately return on investment. * indicates a cost that may be calculated differently for other hospitals.

Figure 2

Community Engagement Model Benefit versus Implementation Difficulty Scores Each bubble represents a service option. The bubbles' size and color indicate the 5-year ROI (blue is + ROI).

Figure 3

Financial Model Benefit versus Implementation Difficulty Scores Each bubble represents a service option. The bubbles' size and color indicate the 5-year ROI (blue is + ROI).

Figure 4

LOS for ED Psychiatric Cases by Involuntary Psychiatric Hold and Psych Transfer Criteria

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- PrioritizationModel.xlsx
- ROIModel.xlsx