Supplement Table of Contents

Supplemental Method

Bootstrapped Confidence Intervals for Clustered estimates with Variable Cluster size

The data for this study was characterized by 3 levels (sites, patients, outcome measured). The intervention varied by time period within the site, so that not all patients had measurements from both time periods, this depended on when they were identified for the study.

The GLIMMIX Procedure in SAS accommodates adjustment for the correlations between measurements within site and patient, however it does not compute the difference in predicted probabilities between time periods and standard errors could not be easily estimated by the delta method. Therefore, upon advice from the editors, we pursued bootstrapping the confidence interval as follows:

1) Identify unique site IDs. In our study there were 9 unique sites.
2) Generate a bootstrap sample by sampling with replacement from the 9 site IDs to obtain 1000 samples of 9 IDs.[1]
3) Reassign the site IDs in each sample so that each resample contains unique IDs. This is to avoid sites from being collapsed together under the same identifier when adjusting for the clustering during the analysis.
4) Repeat the above 3 steps for the patient IDs.[2].
5) Match the patient bootstrapped samples with the site bootstrapped samples using the sampling IDs (1, …, 1000) and the original site IDs. [3]
6) Estimate the model using the Glimmix procedure with a random intercept for the new site ID and new patient ID. Population averaged predicted probabilities for each time period are estimated from the least squares mean statement. The difference between periods is calculated by subtracting the predicted probability of the outcome in the post-intervention period from the pre-intervention period.

```
proc glimmix data=addout;
class pid2 site2 timept (ref='0');
```

```
model &var (event='Yes') = timept /dist = binary LINK=LOGIT solution;
random int/ subject = site2;
random int/ subject = pid2(site2);
lsmeans timept /ilink cl;
by SampleIDsite;
run;
```

7) Bootstrapped estimates ($\hat{\beta}^*$) are re-weighted as $(n^*/n)^{1/2}\,\hat{\beta}^*$ to adjust for the variation in sample size between bootstrapped samples which occurs when bootstrapping clusters with variable cluster size. [4]

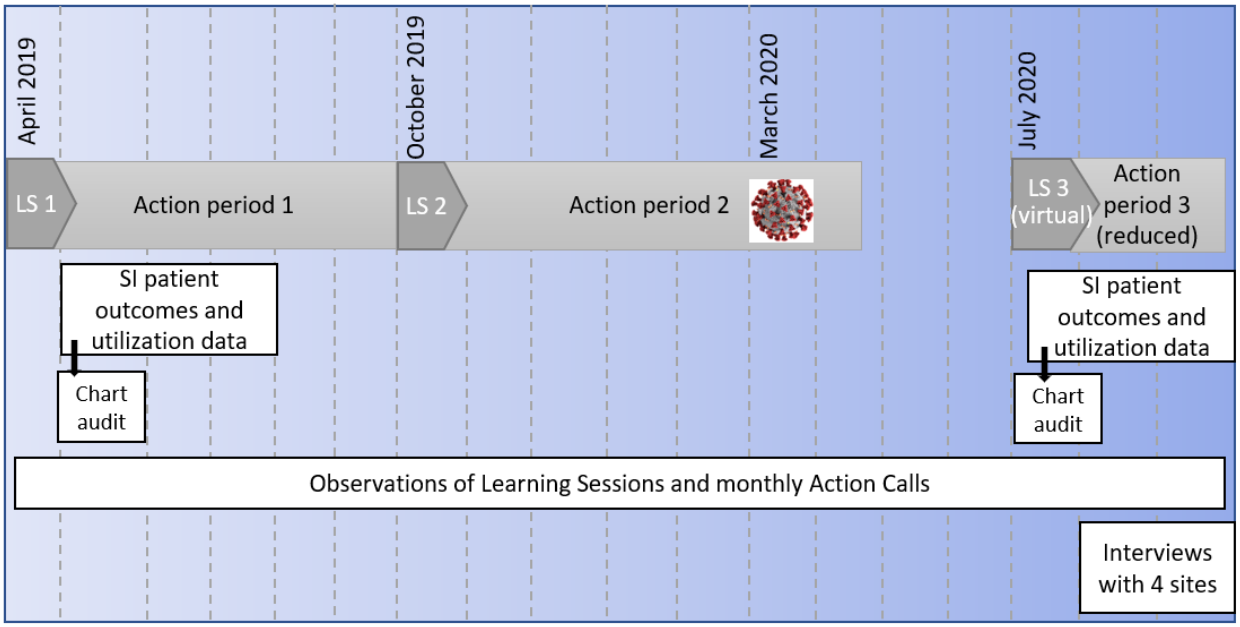
8) Estimate confidence interval from the 2.5 and 97.5 percentiles of the bootstrapped distribution of the weighted estimates.

9) Note that for Supplemental Table 4, which only included the 77 patients with 2 timepoints, there was an additional bootstrap sample of the timepoint IDs. A similar algorithm was applied for these data.

References:

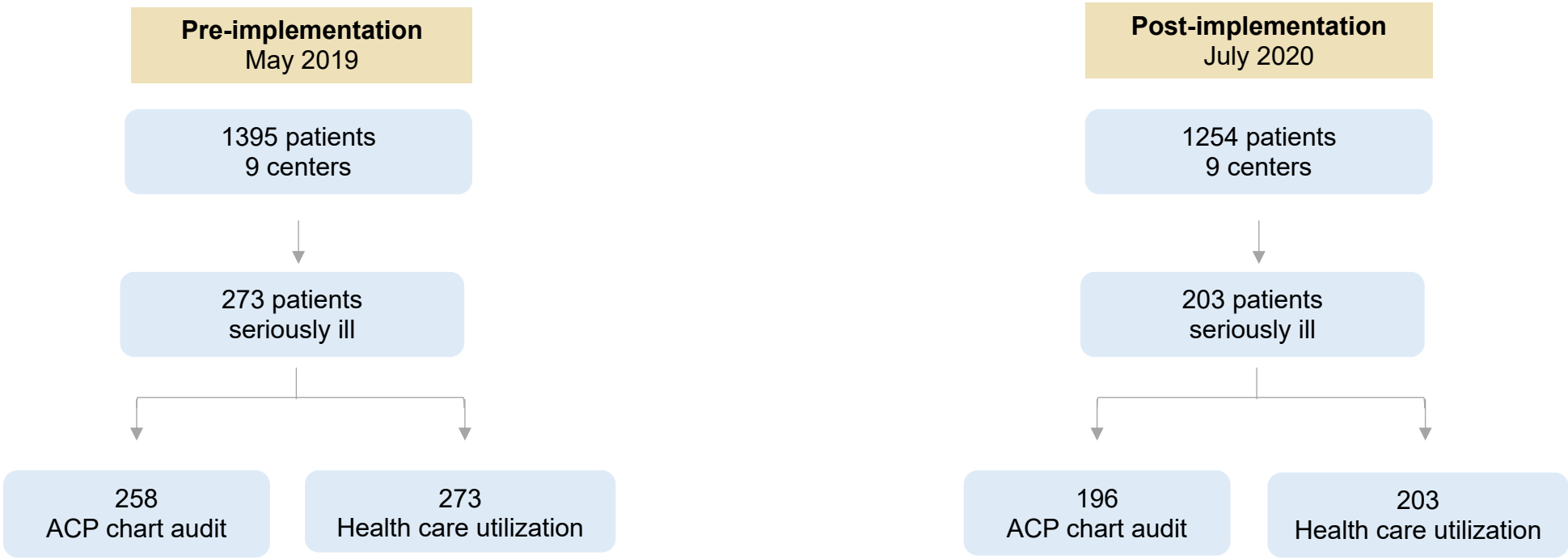
1. https://blogs.sas.com/content/iml/2018/10/24/bootstrap-regression-case-resampling.html
2. https://stats.stackexchange.com/questions/202916/cluster-boostrap-with-unequally-sized-clusters
3. https://biostat.app.vumc.org/wiki/Main/HowToBootstrapCorrelatedData
4. Sherman M, le Cessie S. A comparison between bootstrap methods and generalized estimating equations for correlate outcomes in generalized linear models. Computation in Statistics-Simulation and Computation. 26(3), 901-925 (1997)

Supplemental Figure 1. Timeline of intervention delivery (grey) and data collection (white)



LS = Learning Session

Supplemental Figure 2. Flow diagram of patient identification and outcome assessment in the pre-implementation and post-implementation periods.



Supplemental Table 1. Overview of Learning Session Objectives & Activities

Objectives	**Didactics and Activities**
Learning Session #1	
Understand Pathways Project best practices, including identification of seriously ill patients	• Introduce Pathways Project Best Practices • Describe the "surprise question" as a prognostication tool • Kidney Innovations Café- tabletop discussions
Enhance communication skills for shared decision making and advance care planning	• Goals of Care conversation training using Veterans Administration faculty and curriculum based on VitalTalk (8 hours total) • Communication skills: responding to emotion, eliciting patient's goals, establishing plans to meet goals • Skill practice and role play of common nephrology communication scenarios • Responding to patient values
Integrate supportive care into kidney care setting using incremental changes and PDSA cycle	• Description of IHI Breakthrough Series including PSDA cycles • Each team plans initial change project with faculty input • Develop team charter, including implementation goals
Understand and be prepared for data collection and submission of data for project.	• Description of data collection processes • Demonstration of data collection tools
Learning Session #2	
Demonstrate steps to conduct advance care planning, shared decision making and goals of care with seriously ill kidney patients	• Enhanced Communication Skills Training: using Ask-Tell-Ask; responding to emotion, empathy; • Advance care planning discussion with palliative medicine physician • Patient panel discussion
Describe approaches to providing medical management without dialysis (MMWD)	• Video interview with physician leader in MMWD in Australia • Breakout session – MMWD for CKD teams • Breakout session - Palliative dialysis for dialysis center teams
Identify ways to implement Pathways Best Practices for supportive care of seriously ill patients	• Collaborative sharing through Storyboards. • Idea-sharing between sites

	• Discipline specific conversations to address shared concerns • Implementation strategies
Apply appropriate steps of IHI breakthrough model of healthcare improvement techniques to implement small tests of change.	• Small tests of change; the PDSA cycle • Team working time: fishbone diagram for root cause analysis
Learning Session #3	
Share successes and challenges in implementing supportive care	• Visual storyboard presentations • Interdisciplinary panel of successful project teams
Foster momentum for implementing Pathways best practices	• Discuss implementation challenges • Plans to overcome challenges; collaboratory discussions • Data collection
Use frameworks for sustainability planning to anchor changes to existing processes and "holding the gains"	• "Fostering sustainability" lecture • Developing a sustainability plan • Fishbowl discussion- case study on sustainability plan with one site.
Identify opportunities and resources for spread within organization.	• Panel of innovative US models transforming the kidney care system • How to "nudge" organization culture

Supplemental Table 2. Topic guide for interviews with implementation team members

Main question	Prompts/Probes
Background: I'd like to start with a little bit of background information about yourself.	
First, could you please tell me a bit about yourself, such as your role in the dialysis center, years' experience, how long you've been at [X].	Have you had any formal palliative care training?
What do you enjoy most about your job?	
Pathways collaborative structure: Thanks for that information. I'd now like to talk briefly about the structure of the Pathways project collaborative.	
Did you participate in the: • Learning Sessions? • Monthly webinar action calls? • Have a site visit from the Pathways team?	What did you think about them? Did you find them helpful?
Overall, what did you think about the format of the learning collaborative?	What was the most useful part of the collaborative? What did you think about the small tests of change? Did you learn from other sites? (all teach, all learn) Were the data reports helpful? In what ways? How did you use them?
Change package: Now I'd like to talk about what changes you've made during the Pathways project and in what ways Pathways helped to bring about those changes.	
Starting with identifying seriously ill patients, how have you been able to do that in your center?	What changes did you have to make to accommodate this new practice? Is it a new process or part of existing process (i.e. admission, regular review)? What barriers to implementation did you encounter? What helped to implement those changes?
Thinking about goals of care conversations, how have you been able to do that in your center?	What changes did you have to make to accommodate this new practice? Is it a new process or part of existing process (i.e. admission, regular review)? What barriers to implementation did you encounter? What helped to implement those changes? How do you feel now about having serious illness/ goals of care conversations? How often do you have these types of conversations?

What other elements of the change package have you implemented?	Why were those elements chosen? How did those elements fit with your work? Have any new connections with hospice or palliative care providers been established? Have you implemented palliative dialysis? If so, how?
Can you think of any point where you had an 'aha' moment (i.e. when new practices started to make sense)?	What was it? Why was it so meaningful to you?
Overall, how successful do you think you've been in implementing the change package?	What contributed/ hindered that success? Do you think you're going to be able to sustain the changes that have been made? Why/ why not? How much did the COVID epidemic impact your success?
Lessons learned: Lastly, I'd like to talk about lessons learned.	
What do you think dialysis centers need to know or consider if they were to implement the change package?	How does the current CMS payment model impact on this work?
What would you suggest changing if the Pathways project ran again?	What, if any, incentives do there need to be to make these changes?
Is there something else you'd like to tell me about that I haven't asked about?	

Supplemental Table 3. Advance care planning documentation, palliative care utilization and mortality among seriously ill patients during the pre- and post-implementation periods from multivariable adjusted models accounting for patient demographic characteristics with patient and center as random effects.

Outcome	**Adjusted ***		
	Pre-Implementation predicted probability	**Post-Implementation predicted probability**	**Difference in Predicted Probability (95% CI)**
Advance care planning element			
Complete ACP, (%)	18.9%	55.1%	36.2% (3.9, 75.3)
Goals of care, (%)	75.5%	83.9%	8.4% (-18.8, 58.2)
Surrogate, (%)	70.4%	82.3%	11.9% (-2.1, 41.7)
Advance directives, (%)	13.0%	66.2%	53.2% (1.7, 95.5)
Do not resuscitate or POLST, (%)	4.5%	32.7%	28.2% (1.5, 75.3)
Palliative care utilization			
Reduced frequency dialysis, (%)	**	**	**
Referred to hospice, (%)	**	**	**
Discontinued dialysis, (%)	**	**	**
Mortality	Pre-Implementation rate	Post-Implementation rate	Difference in rate (95% CI)
Death, per 100 person months (95% CI)	2.2 (1.2, 4)	1.9 (0.9, 3.7)	-0.3 (-2.7, 1.3)

Abbreviations: ACP – Advance care planning POLST – physician orders for life-sustaining treatment

* Adjusted estimates are from a generalized linear mixed effects model adjusting for age, sex, race and ethnicity with patient and center included as random effects. Estimates represent the difference in population averaged values for each outcome from the pre-implementation to post-implementation period. Confidence intervals for the difference in predicted probability were estimated by clustered bootstrap.

** could not be estimated due to low frequency of outcome

Supplemental Table 4. Advance care planning documentation among seriously ill patients in both the pre- and post-implementation periods from multivariable adjusted models accounting for patient demographic characteristics with patient and center as random effects.

Advance care planning element	**Adjusted***		
	Pre-Implementation predicted probability N=77	**Post-Implementation predicted probability** N=77	**Difference in Predicted Probability (95% CI)**
Complete advance care planning, %	19.1%	58.3%	39.2 (-11.3, 49.3)
Surrogate, %	68.6%	79.0%	10.4 (-9.0, 26.2)
Goals of care, %	64.0%	79.5%	15.5 (-23.6, 38.5)
Advance directive, %	17.1%	67.0%	49.9 (-5.8, 55.7)
Do not resuscitate or POLST, %	5.6%	28.4%	22.8 (-0.1, 42.0)

* Adjusted estimates are from generalized linear mixed effects models with patient and center included as random effects. Confidence intervals for the difference in predicted probability were estimated by clustered bootstrap.