OREGON HEALTH & SCIENCE UNIVERSITY

SCHOOL OF MEDICINE – GRADUATE STUDIES

Instructions and Explanation of a Cost-Benefit Analysis Tool for Evaluating the Expected Economic Impacts of a Remote Patient Monitoring Program to Prevent Congestive Heart Failure Readmissions

By

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A CAPSTONE PROJECT

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School of Medicine

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Master of Biomedical Informatics

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Value of Cost Benefit Analysis Tool

A cost-benefit analysis (CBA) tool allows a healthcare organization to input important variables related to a potential project to determine the expected economic impact if the project is implemented. The CBA tool created for this capstone project is for evaluating the potential financial implications of having a remote patient monitoring (RPM) program designed to prevent congestive heart failure (CHF) readmissions.

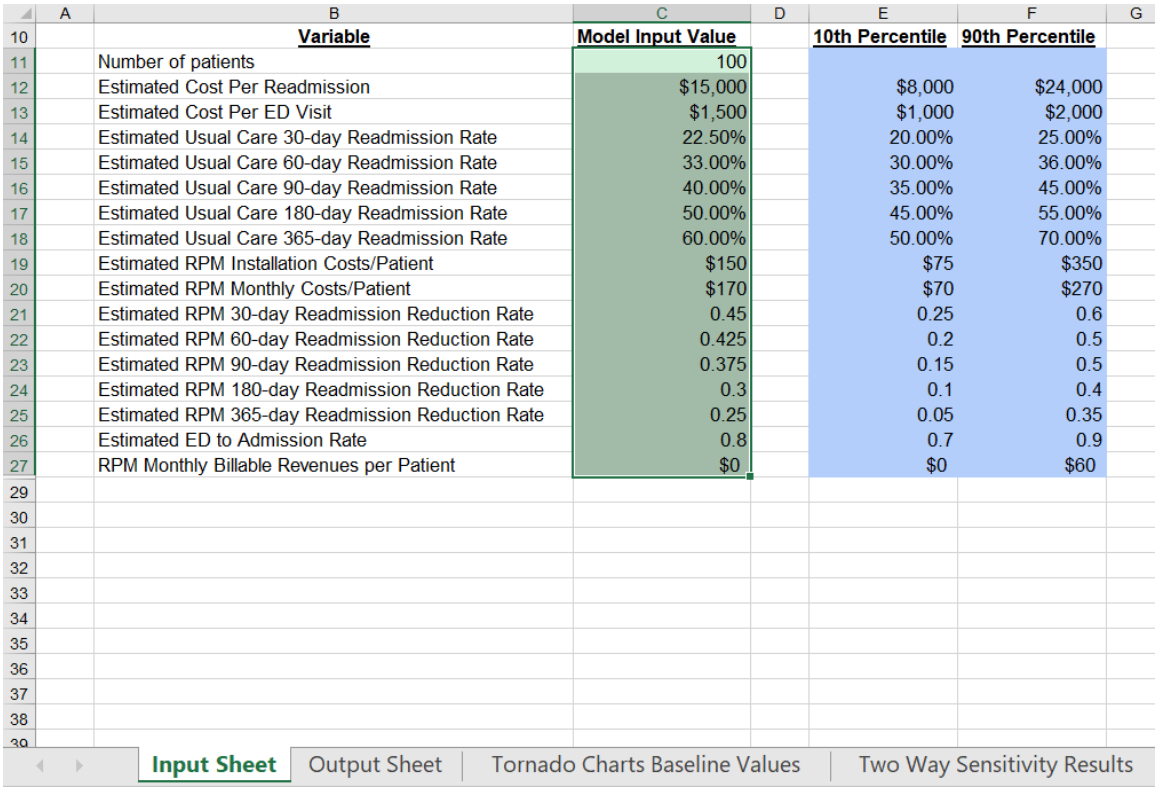
The associated capstone thesis details the evidence for the substantial expected benefits of an RPM program to prevent CHF readmissions. The thesis also details the evidence for the baseline and 10^{th} and 90^{th} percentile variable values for the CBA model. Users of this CBA tool that want more background information on RPM programs to prevent CHF readmissions along with a more detailed explanation of the construction of the CBA model are invited to consult the associated thesis.

The scenarios considered for this CBA tool are usual care versus RPM for 30-days, 60-days, 90-days, 180-days, or 365-days after an index CHF admission.

Instructions for How to Use the CBA Tool

Step 1: The user may override any of the baseline values in cells C11 through C27 on the "Input Sheet" tab as desired (see highlighted cells in Figure 1).

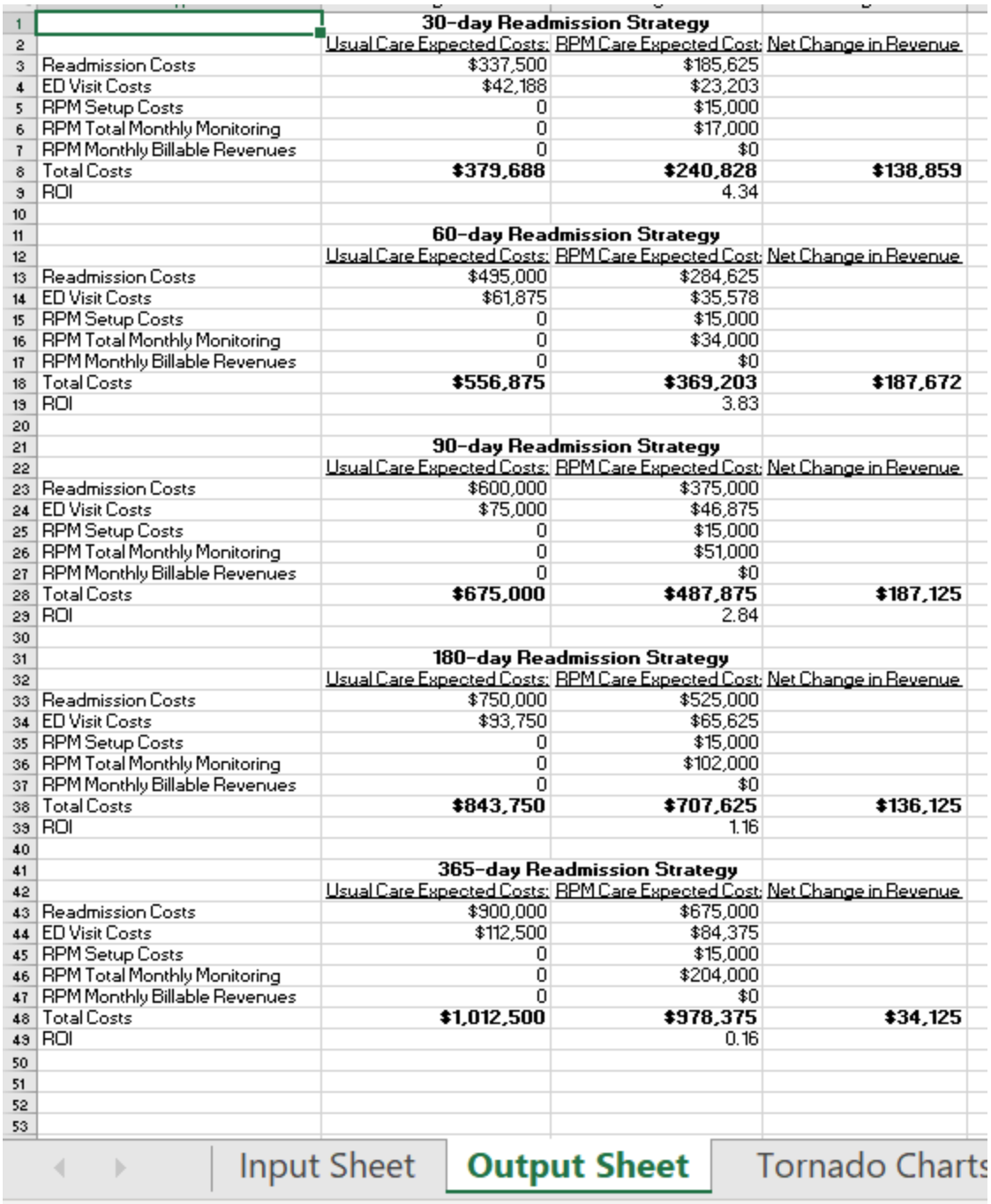
Of note, the cells from C11 through C27 on the "Input Sheet" tab of the tool are populated with baseline values derived from the literature. However, the user is encouraged to input their healthcare organization's specific values, if known.



	Variable	Model Input Value	10th Percentile	90th Percentile
11	Number of patients	100		
12	Estimated Cost Per Readmission	$15,000	$8,000	$24,000
13	Estimated Cost Per ED Visit	$1,500	$1,000	$2,000
14	Estimated Usual Care 30-day Readmission Rate	22.50%	20.00%	25.00%
15	Estimated Usual Care 60-day Readmission Rate	33.00%	30.00%	36.00%
16	Estimated Usual Care 90-day Readmission Rate	40.00%	35.00%	45.00%
17	Estimated Usual Care 180-day Readmission Rate	50.00%	45.00%	55.00%
18	Estimated Usual Care 365-day Readmission Rate	60.00%	50.00%	70.00%
19	Estimated RPM Installation Costs/Patient	$150	$75	$350
20	Estimated RPM Monthly Costs/Patient	$170	$70	$270
21	Estimated RPM 30-day Readmission Reduction Rate	0.45	0.25	0.6
22	Estimated RPM 60-day Readmission Reduction Rate	0.425	0.2	0.5
23	Estimated RPM 90-day Readmission Reduction Rate	0.375	0.15	0.5
24	Estimated RPM 180-day Readmission Reduction Rate	0.3	0.1	0.4
25	Estimated RPM 365-day Readmission Reduction Rate	0.25	0.05	0.35
26	Estimated ED to Admission Rate	0.8	0.7	0.9
27	RPM Monthly Billable Revenues per Patient	$0	$0	$60

Figure 1 – Input cells for the CBA tool.

Step 2: After the user updates the model input values as desired, they click the "Output Sheet" tab to review the results (see Figure 2).



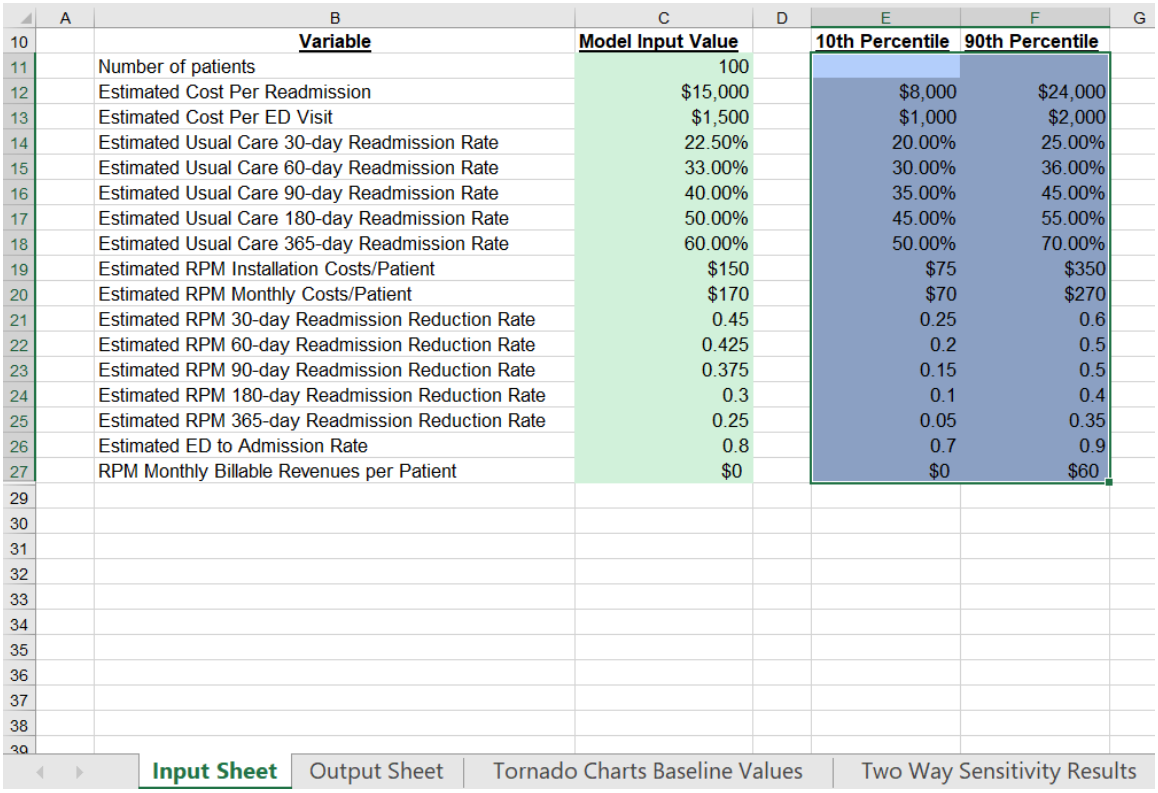
1		**30-day Readmission Strategy**		
2		Usual Care Expected Costs:	RPM Care Expected Cost:	Net Change in Revenue
3	Readmission Costs	$337,500	$185,625	
4	ED Visit Costs	$42,188	$23,203	
5	RPM Setup Costs	0	$15,000	
6	RPM Total Monthly Monitoring	0	$17,000	
7	RPM Monthly Billable Revenues	0	$0	
8	Total Costs	**$379,688**	**$240,828**	**$138,859**
9	ROI		4.34	
10				
11		**60-day Readmission Strategy**		
12		Usual Care Expected Costs:	RPM Care Expected Cost:	Net Change in Revenue
13	Readmission Costs	$495,000	$284,625	
14	ED Visit Costs	$61,875	$35,578	
15	RPM Setup Costs	0	$15,000	
16	RPM Total Monthly Monitoring	0	$34,000	
17	RPM Monthly Billable Revenues	0	$0	
18	Total Costs	**$556,875**	**$369,203**	**$187,672**
19	ROI		3.83	
20				
21		**90-day Readmission Strategy**		
22		Usual Care Expected Costs:	RPM Care Expected Cost:	Net Change in Revenue
23	Readmission Costs	$600,000	$375,000	
24	ED Visit Costs	$75,000	$46,875	
25	RPM Setup Costs	0	$15,000	
26	RPM Total Monthly Monitoring	0	$51,000	
27	RPM Monthly Billable Revenues	0	$0	
28	Total Costs	**$675,000**	**$487,875**	**$187,125**
29	ROI		2.84	
30				
31		**180-day Readmission Strategy**		
32		Usual Care Expected Costs:	RPM Care Expected Cost:	Net Change in Revenue
33	Readmission Costs	$750,000	$525,000	
34	ED Visit Costs	$93,750	$65,625	
35	RPM Setup Costs	0	$15,000	
36	RPM Total Monthly Monitoring	0	$102,000	
37	RPM Monthly Billable Revenues	0	$0	
38	Total Costs	**$843,750**	**$707,625**	**$136,125**
39	ROI		1.16	
40				
41		**365-day Readmission Strategy**		
42		Usual Care Expected Costs:	RPM Care Expected Cost:	Net Change in Revenue
43	Readmission Costs	$900,000	$675,000	
44	ED Visit Costs	$112,500	$84,375	
45	RPM Setup Costs	0	$15,000	
46	RPM Total Monthly Monitoring	0	$204,000	
47	RPM Monthly Billable Revenues	0	$0	
48	Total Costs	**$1,012,500**	**$978,375**	**$34,125**
49	ROI		0.16	
50				
51				
52				
53				

Input Sheet | **Output Sheet** | Tornado Charts

Figure 2 – Example output as displayed on the "Output Sheet"

Optional Instructions: deterministic sensitivity and two-way sensitivity analyses

Step 1: The user may override any of the suggested 10th and 90th percentile values, derived from the literature, in cells E11 through E27 and F11 through F27, on the "Input Sheet" tab as desired (see highlighted cells in Figure 3).



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Input Sheet | Output Sheet | Tornado Charts Baseline Values | Two Way Sensitivity Results

Figure 3 – Input cells for deterministic and two-way sensitivity analyses.

Step 2: Full instructions on how to download the data analysis add-on and on how to conduct a deterministic and two-way sensitivity analyses can be found at:

http://mba.tuck.dartmouth.edu/tookit/

Tornado Charts and Two Way Sensitivity Results

The "Tornado Charts Baseline Values" tab contains deterministic sensitivity analysis results for each of the five scenarios, using baseline values, and displayed in the form of Tornado charts (see Figure 4).

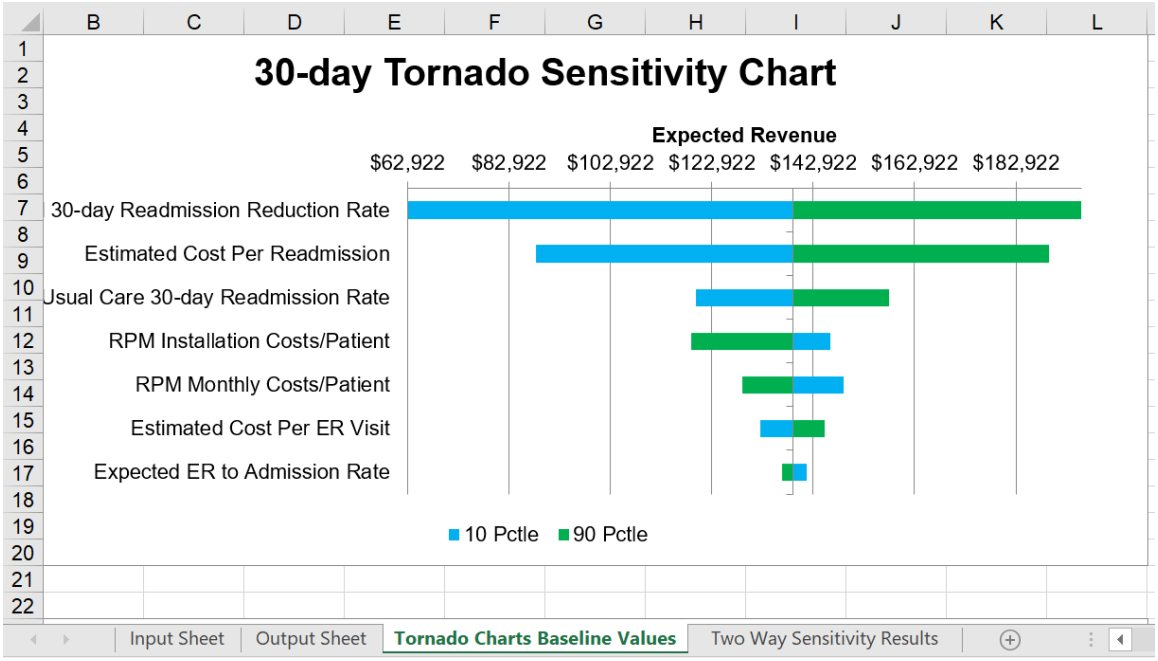

Figure 4 – Tornado chart output for the 30-day RMP scenario

The "Two Way Sensitivity Results" tab contains two-way sensitivity results using the 10th through the 90th percentile values for the two variables that were found to be most important for expected changes in revenue in the deterministic sensitivity analysis (see Figure 5).

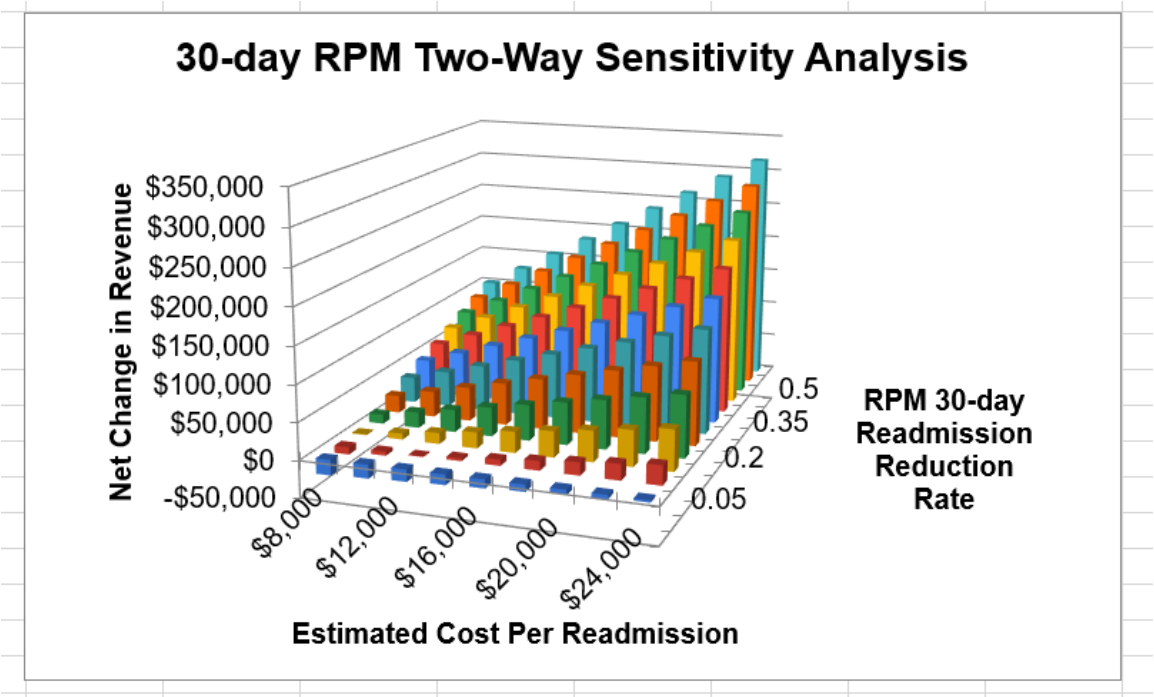

Figure 5 – Two-Way Sensitivity Analysis Results for the 30-day RPM scenario

Optional Instructions: altering the CBA tool

Step 1: If a user wishes to alter the model (add or remove a variable, etc.), the user should create a copy of this Excel spreadsheet.

Step 2: After saving a copy. Unprotect the "Input Sheet" and "Output Sheet" tabs with the password: "CBA"

Step 3: Add or subtract variables and formulas as desired.

Basic Explanation and List of CBA Formulas

To calculate the expected changes in revenue and return on investment (ROI) with an RPM program, the first step is to calculate expected costs of usual care for each of the five scenarios considered for this CBA tool. To reiterate, the scenarios considered for this

CBA tool are usual care versus RPM for 30-days, 60-days, 90-days, 180-days, or 365-days after an index CHF admission.

For the purposes of this CBA tool, total expected usual care cost is defined as the sum of expected readmission costs plus the expected emergency department (ED) visit costs during the timeframe of interest for each scenario.

In all following equations, (n) represents the number of patients in the equation.

> Expected usual care readmission cost = (n * cost per readmission * usual care readmission rate)

> Expected usual care ED cost = (n * estimated cost per ED visit) * (estimated usual care readmission rate / estimated ED to readmission rate)

> Total expected usual care cost = Expected usual care readmission cost + Expected usual care ED cost.

The next step is to calculate the expected cost of care for each RPM scenario. This value is obtained by summing the expected RPM readmission costs, expected RPM ED costs, expected RPM setup costs, and expected RPM monthly monitoring costs.

> Expected RPM readmission cost = (n * estimated cost per readmission * estimated usual care readmission rate) * (1-estimated RPM readmission reduction rate)

Expected RPM ED cost = (n * estimated cost per ED visit * estimated usual care readmission rate / estimated ED to readmission rate) *(1-estimated RPM readmission reduction rate)

Expected RPM setup cost = (n * estimated RPM installation costs per patient)

Expected RPM monthly monitoring cost = (n * estimated monthly PRM costs per patient * number of months)

Total expected RPM cost = Expected RPM readmission cost + Expected RPM ED cost + Expected RPM setup cost + Expected RPM monthly monitoring cost

The net change in revenue under each scenario is then calculated as:

Net change in revenue = Total expected usual care cost – Total expected RPM care cost

Return on investment (ROI) is calculated for each scenario as:

$$ROI = \frac{Net\ change\ in\ revenue}{Expected\ RPM\ setup\ cost + Expected\ RPM\ monthly\ monitoring\ cost}$$