

THE ACIST | CVi® VARIABLE RATE CONTRAST DELIVERY SYSTEM Reduces Costs of Coronary Catheterizations Compared With Manual Injection

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INTRODUCTION

- Approximately 2.26 million diagnostic angiographies and 883,900 PCIs were performed in the U.S. in 2016. Diagnostic angiographies are expected to increase 0.6% annually.¹
- A central feature of vascular catheterizations is the injection of radiopaque contrast media into the patient's bloodstream to visualize vascular structures using fluoroscopic imaging. Primary methods for contrast delivery include manual hand-manifold, variable rate injectors, or fixed rate-power injectors.^{2,3}
- The use of contrast media may lead to contrast-induced acute kidney injury (CI-AKI) in patients undergoing fluoroscopy-guided angiographic procedures via medullary hypoxia.⁴
 - The amount of contrast volume used is directly related to CI-AKI incidence, and is a key modifiable risk factor.⁵⁻⁸ Comorbidities, eg chronic kidney disease and diabetes, may increase the risk of CI-AKI.⁹
 - CI-AKI is associated with significantly longer hospital stays, and may result in hospital treatment costs of \$13,294* per patient (n = 24,414).¹⁰
- The ACIST | CVi® contrast delivery system was designed to address the challenges of current care as demonstrated in the meta-analysis by Minsinger et al. of 10 studies:
 - Contrast use was significantly reduced by almost 45 mL (P < 0.00001) with automated vs. manual contrast injection.¹¹
 - CI-AKI was significantly reduced by 15% with ACIST | CVi® compared with manual injection (RR = 0.85, P = 0.0002).¹¹
- Therefore, an economic model was developed to assess the budget impact of switching from manual methods to ACIST | CVi® for contrast injection.

OBJECTIVES

- This study performed a budget impact analysis comparing costs of automated contrast injection, using the ACIST | CVi® variable rate contrast delivery system, and manual contrast injection, from a U.S. hospital perspective.

METHODS

An economic model was developed to assess the use of the ACIST | CVi® system for contrast injection. It compared assumptions (Table 1) made for:

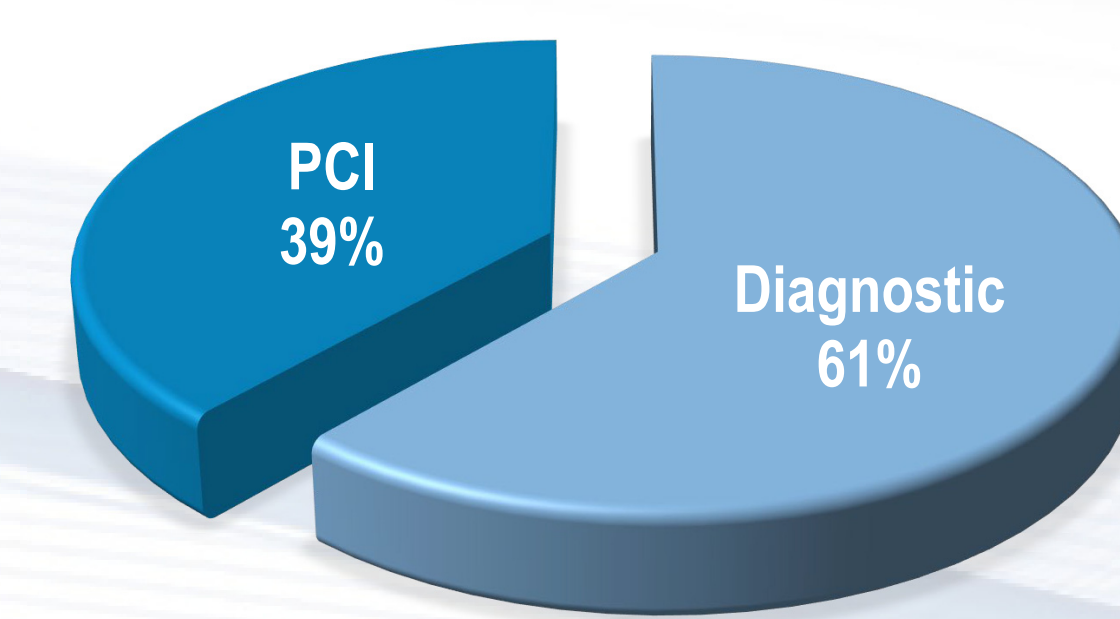
- Current practice: all procedures were performed using manual injection
 - Future practice: most procedures switched to using the ACIST | CVi® system.
- The annual cohort analyzed 3,500 patients
 - There were 14 coronary catheterizations per day (based on the assumptions of an institution with five or six catheterization suites, in which two or three procedures are performed per day in each).
 - The distribution of procedures is shown in Figure 1.

METHODS CONT.

Table 1: Current and Future Scenarios of Injection Methods and use of 6 F vs. <6 F Catheters

	Current Scenario	Future Scenario
Injection Method		
Manual Injection	100%	10%
ACIST CVi®	0%	90%
Use of 6 F vs. <6 F Catheters		
6 F	90%	80%
<6 F	10%	20%

Figure 1: Procedure Distribution



- Key model parameters included in the base-case analysis were contrast use, CI-AKI incidence rates, contrast costs, and product acquisition costs.
- Model input values were primarily informed by meta-analyses, randomized trials, and costing studies.
- Sensitivity analyses also additionally considered vascular closure device (VCD) use and complications avoided with automated contrast injection.
- Table 2 shows the key model inputs.

Table 2: Model Inputs for Manual Injection and ACIST CVi

	Manual Injection	ACIST CVi	Ref.
Average contrast use (mL)	202	-45	11
Cost of Contrast Media (per mL)		\$0.12	Data on file
CI-AKI Incidence (diagnosis)	11.6%	9.9%	11
CI-AKI Incidence (PCI)	3.5%	2.9%	11
In-Hospital Cost per CI-AKI Case		\$13,294	10
Equipment Cost Components	<ul style="list-style-type: none"> Transducer High Pressure Tubing Power Syringe Manifold (# of Ports) 	<ul style="list-style-type: none"> Capital Equipment Cost Syringe Hand Controller Manifold 	Data on file
Diagnostic Procedure Time (mins)	16	11	12
VCD Use (%)	71.4%	25%	13
Cost of VCD		\$200	12

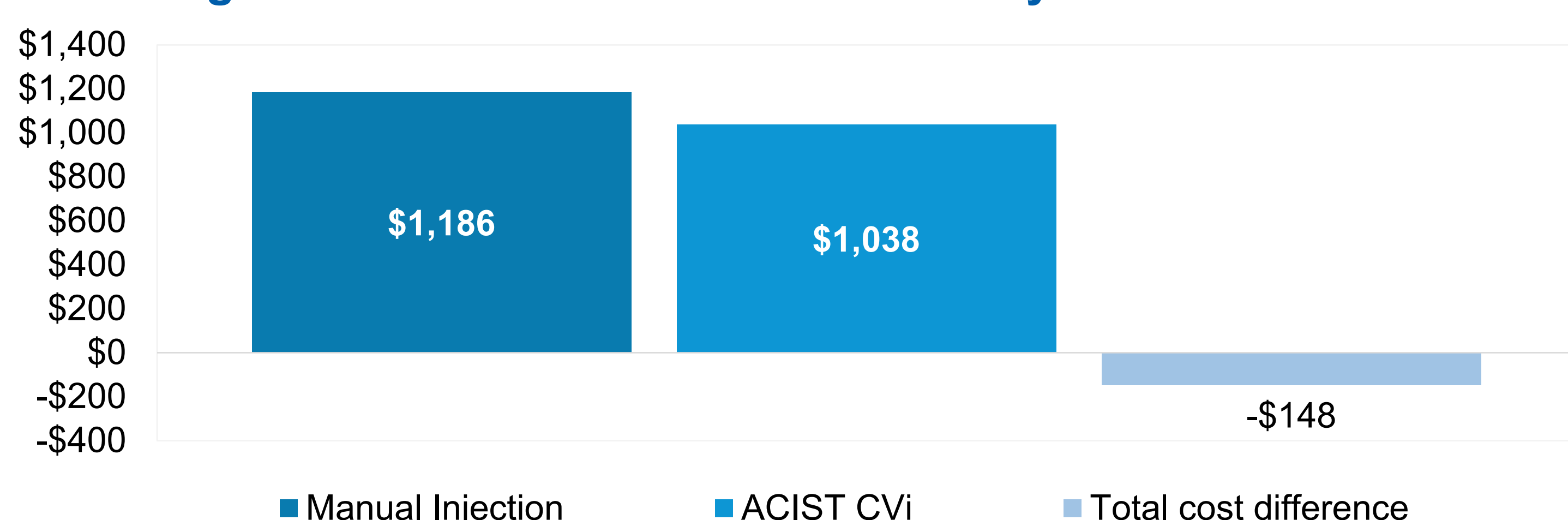
Table 3: Model Inputs for Complication Variables

Vascular Complications and Costs	<6 F	6 F	Ref.
Complication Rates	10%	27%	14
LOS and Hospital Stay Cost	Without Vascular Complications	With Vascular Complications	Ref.
LOS (days)	1.2	1.9	15
Hospital Stay Cost (per day)		\$2,441	16

RESULTS

- The results of all the analyses demonstrated cost savings with ACIST | CVi®.
- The main analysis considered contrast use, CI-AKI incidence, and equipment costs and showed savings of \$148 per patient (Figure 2).

Figure 2: Total U.S. Costs Per Patient by Treatment

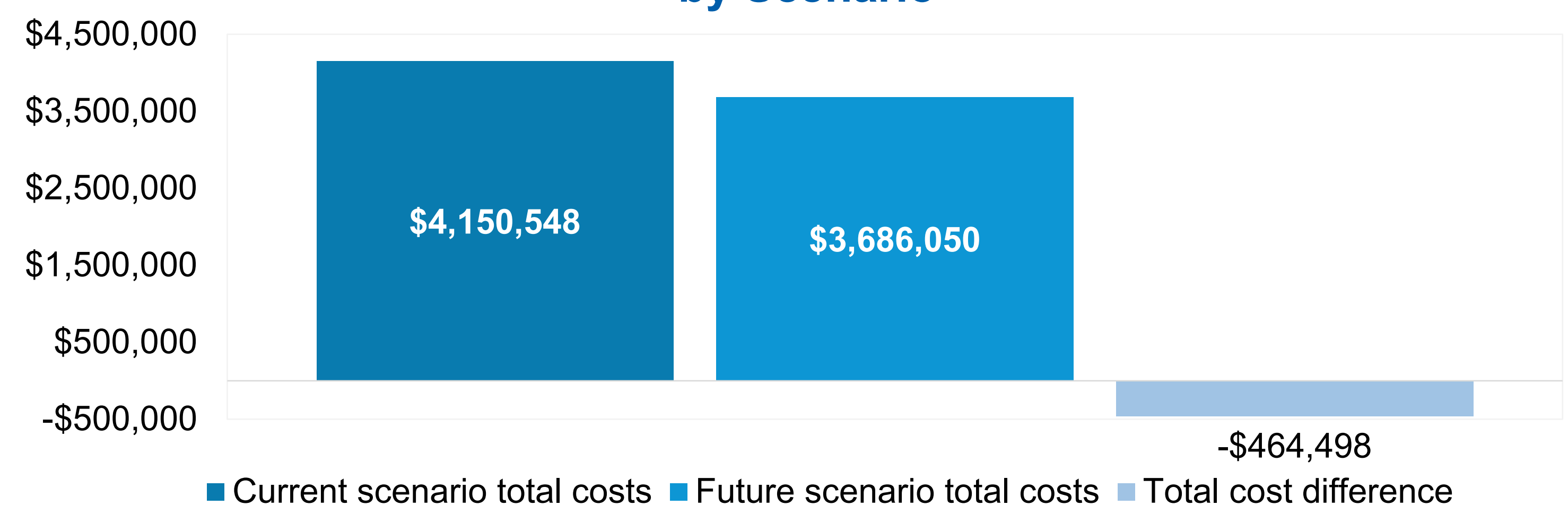


- When considering the cohort of 3,500 patients per year, switching from 100% manual injection to 90% ACIST | CVi® resulted in savings of \$464,498 (Table 4 & Figure 3).

Table 4: Results for Annual Cohort of 3,500 Patients Over 1-Year Horizon

	Current Scenario	Future Scenario	Difference
Contrast Use (mL)	705,933	565,254	-140,679
Contrast Costs (\$)	\$84,712	\$67,831	-\$16,881
CI-AKI Cases	296	256	-40
CI-AKI Treatment Costs (\$)	\$3,938,086	\$3,406,44	-\$531,642
Disposable Costs (\$)	\$127,750	\$201,775	\$74,025
Capital Equipment Costs (\$)	\$0	\$10,000	\$10,000
Total Costs (\$)	\$4,150,548	\$3,686,050	-\$464,498

Figure 3: Total Current and Future Costs (USD) by Scenario



- Sensitivity analyses considering VCD use alone and VCD use plus complications avoided with automated contrast injection demonstrated incremental savings compared with the main analysis (Table 5 & Figures 4 and 5).

Table 5: Results for Annual Cohort of 3,500 Patients Over 1-Year Time Horizon for Sensitivity Analyses Including VCD Costs and Additional LOS Costs

	Current Scenario	Future Scenario	Difference
VCDs			
VCD Use	2,499	1,037	-1,462
VCD Costs (\$)	\$499,800	\$207,480	-\$292,320
Total Costs + VCDs (\$)	\$4,650,348	\$3,893,530	-\$756,818
Complications			
Complication Cases	886	826	-59
Additional LOS Costs (\$)	\$1,513,054	\$1,411,386	-\$101,668
Total Costs + VCDs and Complications (\$)	\$6,163,402	\$5,304,916	-\$858,486

Figure 4: Total Current and Future Costs (USD) including VCDs by Scenario

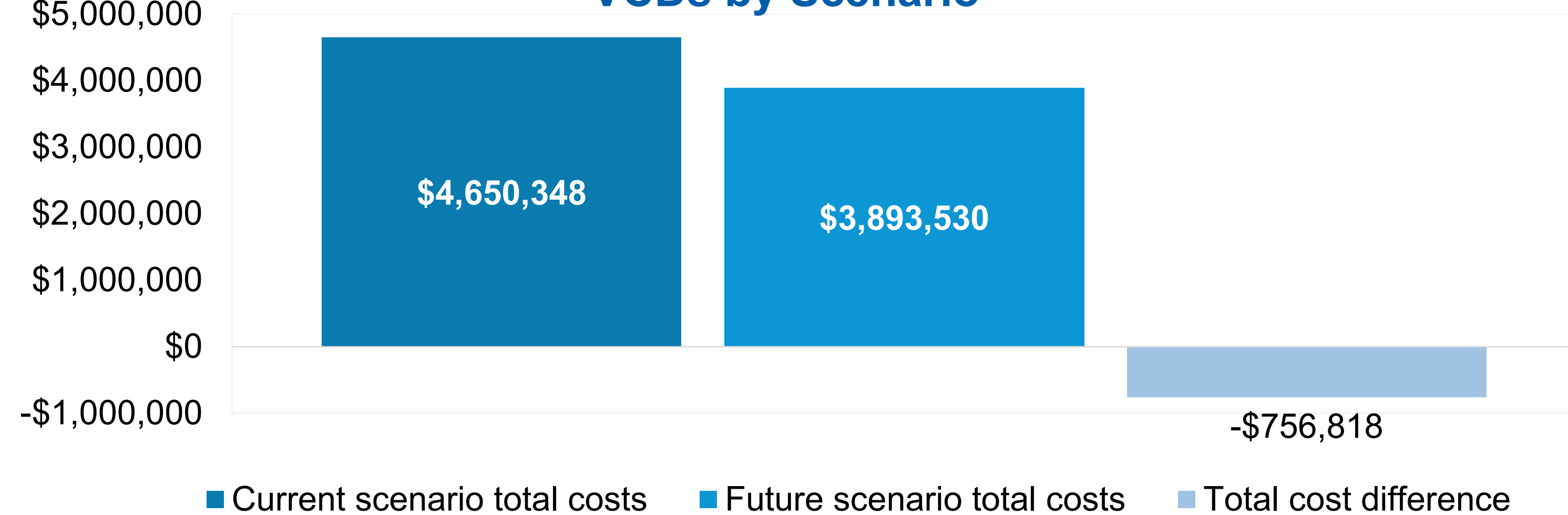
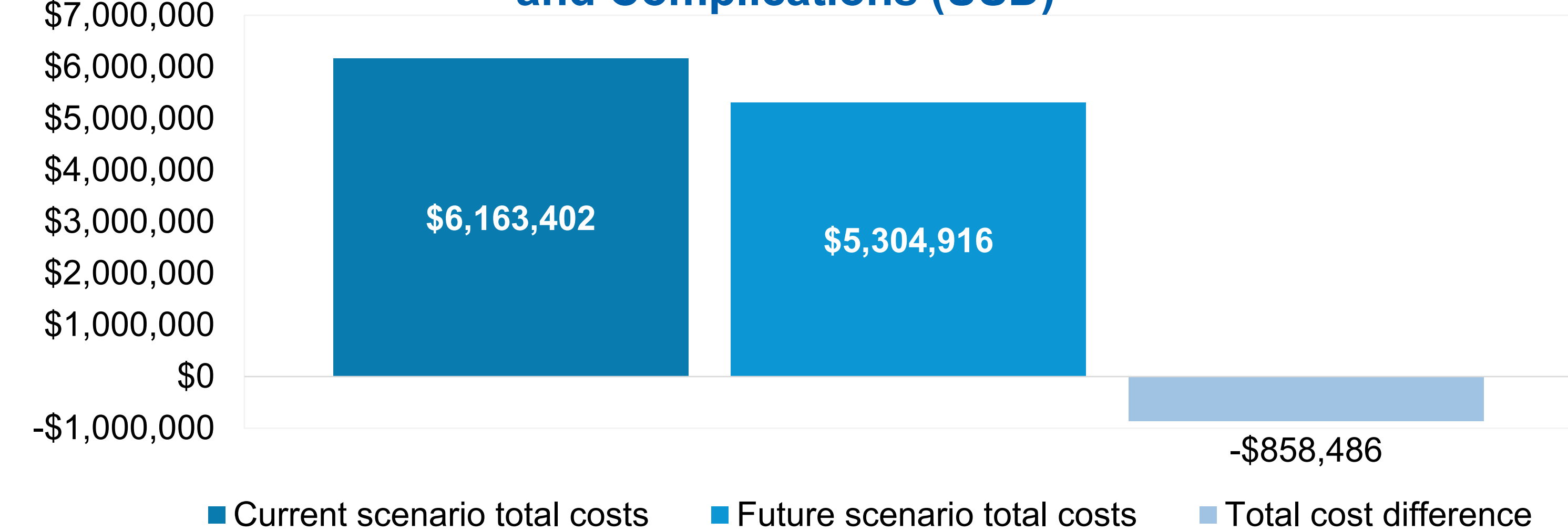


Figure 5: Total Current and Future Costs Including VCDs and Complications (USD)



CONCLUSION

- This economic analysis predicted that automated contrast injection with the ACIST | CVi® system can lead to important institutional cost savings due to avoided contrast and complication related resource use.
- Automated contrast injectors should be considered as part of a comprehensive approach to reduce CI-AKI and the costs of cardiac catheterization procedures.
- Future study should consider the budget impact of automated contrast injection in other interventional procedures.

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Abbreviations: CI-AKI, Contrast-induced acute kidney injury; CPI, consumer price index; F, French size; LOS, Length of stay; PCI, percutaneous coronary intervention; RR, risk ratio; VCD, vascular closure device



*Inflated to 2018 USD from 2010 USD using the medical care component of CPI.