

Reduction of Modeled Healthcare Utilization and Costs Through Early Detection of Acute Kidney Injury

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BACKGROUND

- Acute kidney injury (AKI) is associated with substantial risk of morbidity and mortality¹⁻³
- Recent literature estimates AKI is associated with 13% to 18% of hospital admissions² and affects up to 50% of critically ill patients¹
- Treatment for AKI involves substantial hospital resources including critical care interventions and potentially dialysis
- The current standard of care (SOC) for AKI diagnosis involves measuring serial serum creatinine and urine output, though these assessments are lagging indicators of kidney damage
- Earlier identification of patients at risk of AKI may improve patient management and associated outcomes, resulting in reduced AKI severity and lower costs to hospital systems
- The NEPHROCHECK[®] Test, a new biomarker-based test, measures tissue inhibitor of metalloproteinase 2 and insulin-like growth factor binding protein 7 ([TIMP-2]·[IGFBP7]) to aid in clinical evaluation of ICU patients who have, or have had within the past 24 hours, acute cardiovascular and/or respiratory compromise and are at risk of developing moderate to severe AKI within 12 hours⁴

OBJECTIVE

- To estimate the budget impact of adding NEPHROCHECK to SOC in three hypothetical hospitals with varying payer mixes and test utilization rates

METHODS

Model Design

- A model was developed in Microsoft Excel to estimate the budget impact (2017 USD) of adding NEPHROCHECK to SOC from the perspective of a hypothetical United States (US) hospital system
- Data from peer-reviewed literature was used to determine healthcare utilization and costs
- The model was used to consider three hypothetical hospitals, varying in payer mix and test utilization rates

Model Assumptions

- Perspective: Hypothetical hospitals in the US treating 10,000 patients annually
- Population:
 - Assumed 10% of hospitals' patients are ages 21+ and treated in the ICU for cardiovascular or respiratory compromise, resulting in 1,000 potential patients to be tested with NEPHROCHECK
 - Share of payer coverage (public [Medicare/Medicaid], private, or uninsured) varies across hospitals, affecting amount of compensated care
 - Test adoption rate varies by hospital
- Severity level of AKI patients, treatment costs, and hospital re-admission rates are the same across all three hospitals

Key Model Inputs

- Table 1 reports the effect of NEPHROCHECK on diagnostic efficacy
- Table 2 describes intensity of resource use and likelihood of readmission by stage of AKI, as well as associated costs

Table 1. Diagnostic efficacy: share of patients by severity after intervention in SOC only vs. NEPHROCHECK⁵

	No AKI	Mild AKI	Moderate AKI	Severe AKI
SOC Only	43%	39%	14%	4%
NEPHROCHECK	55%	39%	5%	1%

Table 2. Hospital utilization among patients evaluated for AKI by severity along with associated hospital utilization and costs

	Hospital Utilization				Costs
	No AKI	Mild AKI	Moderate AKI	Severe AKI	
ICU Bed Days	1	2	3	5	\$5,000/Day
Non-ICU Bed Days	4	7	8	11	\$2,500/Day
30-Day Re-admission Rate	9%	16%	22%	29%	\$9,000/Re-admission

METHODS (CONTINUED)

Key Model Inputs Continued

- Differing payer mix and test utilization rates for the three hypothetical hospitals are shown in Table 3. Hospital A is the base case hospital.

Table 3. Payer characteristics and test utilization rates for three hypothetical hospitals examined in the model

	Payer Mix			Test Utilization Rate
	Medicare/Medicaid	Private	Uninsured	
Hospital A	50%	40%	10%	50%
Hospital B	75%	10%	15%	35%
Hospital C	35%	60%	5%	65%

OUTCOMES

- Differences between using SOC versus NEPHROCHECK plus SOC were estimated across the following outcomes:
- Length of ICU and non-ICU inpatient stays
- 30-day re-admissions
- Net impact on hospital budget
- Net savings per tested patient

RESULTS

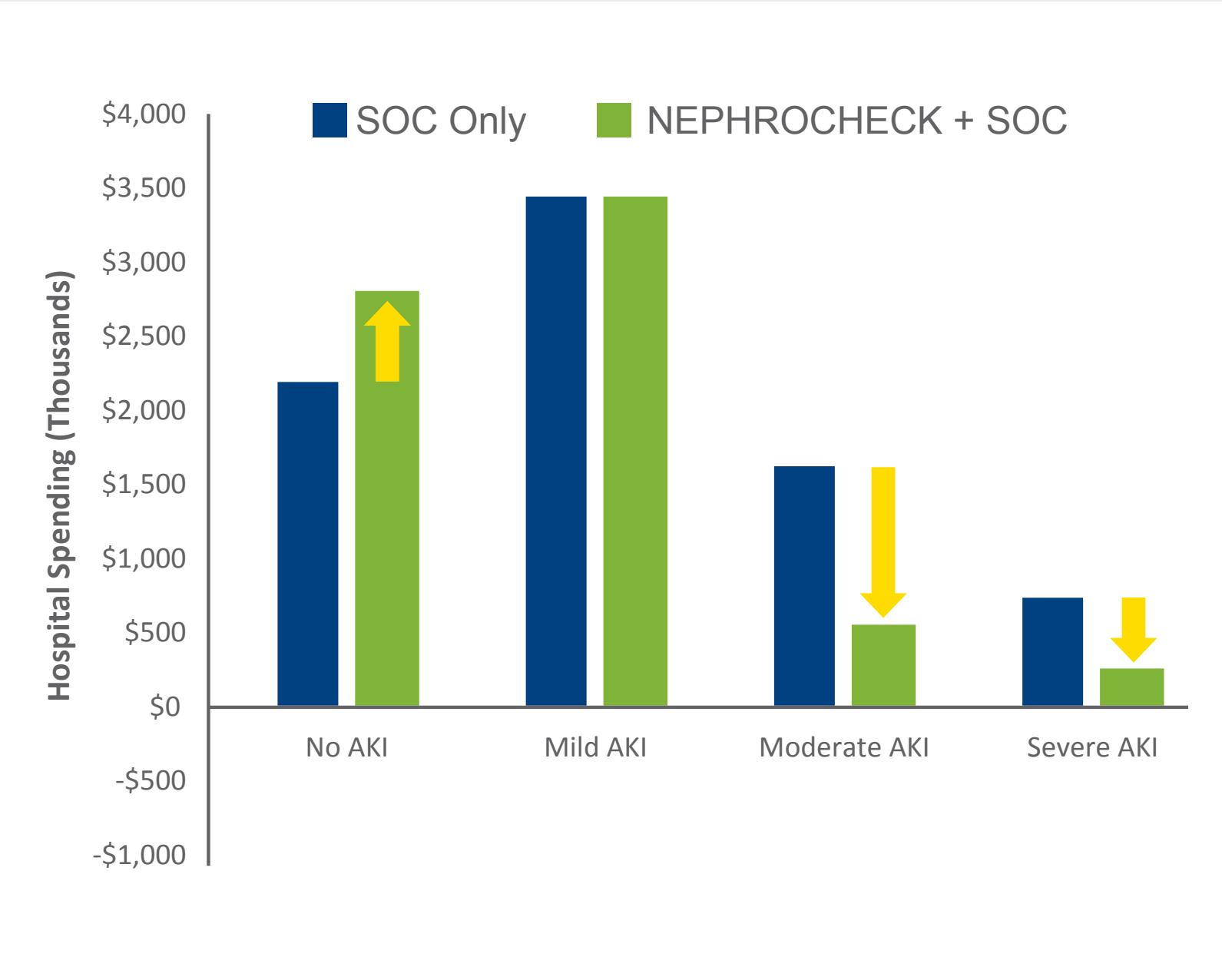
- All three hypothetical hospitals are estimated to experience significant savings from adding NEPHROCHECK to SOC (Table 4)
- Savings are positive per tested patient, suggesting that higher utilization of NEPHROCHECK would increase savings, all else being equal
- Savings are strongly affected by payer mix, as the model assumes capitated payments for government payers and per-diem payments for commercial payers
- As a result, Hospital B (75% Medicaid/Medicare) benefits most from a reduction in uncompensated care, despite the lower utilization rate of NEPHROCHECK

Table 4. Utilization reduction, annual net savings from uncompensated care and per tested patient net savings for the three hypothetical hospitals

	Number of Tested Patients	Reduction in Uncompensated ICU Bed Days	Reduction in Uncompensated Non-ICU Bed Days	Overall Annual Net Savings	Per Tested Patient Net Savings
Hospital A	500	91	170	\$789,104	\$1,578
Hospital B	350	96	178	\$872,985	\$2,494
Hospital C	650	79	147	\$627,924	\$966

- Figure 1 illustrates the shift in cost of care from reduction in severity of AKI due to earlier diagnosis with NEPHROCHECK, using Hospital A as an example
- Burden of treatment is shifted to less severe cases of AKI or to no AKI

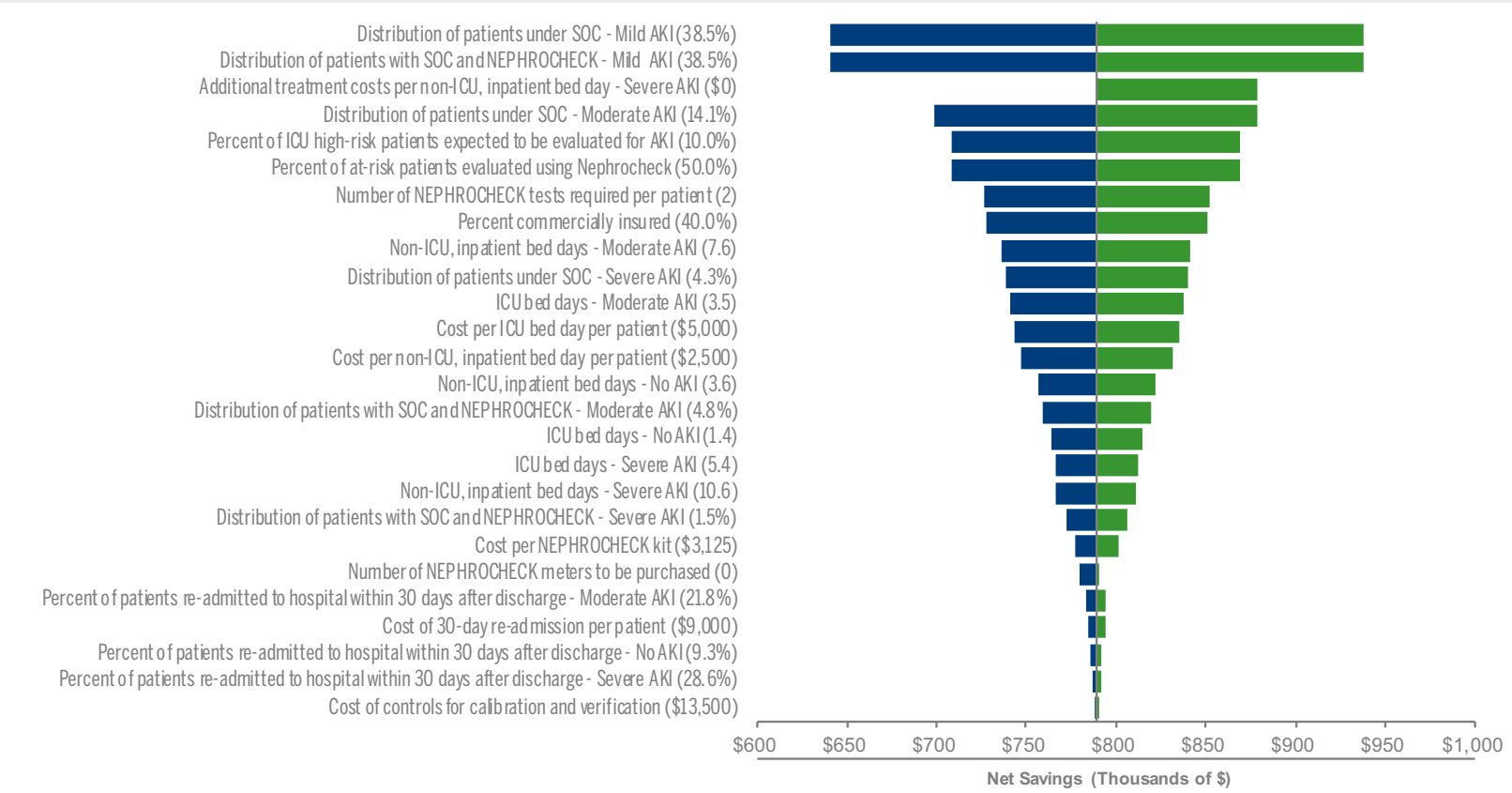
Figure 1. Spending by AKI severity level for Hospital A in the model



SENSITIVITY ANALYSIS

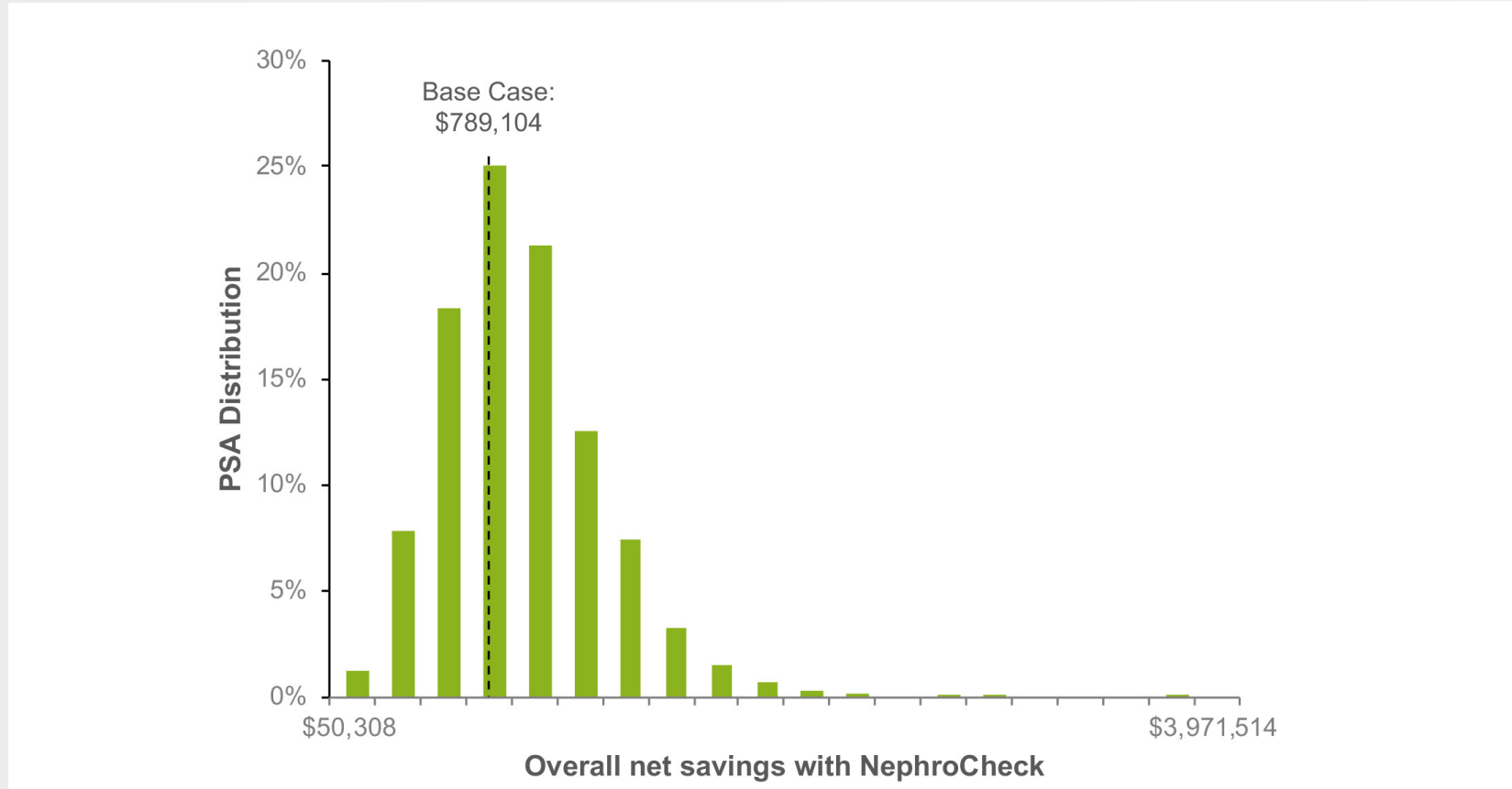
- Sensitivity analyses were conducted to examine the effect of model assumptions on estimated savings (Hospital A)
- One-way deterministic sensitivity analysis (DSA) was run by changing each parameter value in turn by ±10%, while keeping all others constant (Figure 2)

Figure 2. One-way DSA for Hospital A



- Probabilistic sensitivity analysis (PSA) made use of Monte Carlo simulation techniques, relying on pre-specified probability distributions for each input and running 5,000 simulations (Figure 3)
- As seen in Figure 3, the addition of NEPHROCHECK to SOC resulted in cost savings to the hospital in 99% of scenarios

Figure 3. PSA for Hospital A



DISCUSSION AND LIMITATIONS

- Earlier identification of AKI allows for more timely intervention and improved outcomes
- The results of the study suggest that adding NEPHROCHECK to SOC would be advantageous for earlier identification of AKI and reduction of total healthcare costs in economically diverse hospitals
- Sensitivity analyses demonstrate that estimated savings are robust
- Due to the lack of real-world data for NEPHROCHECK, the model relies on the best literature-based parameters for inputs; further research is needed to evaluate the budget impact of NEPHROCHECK in real-world settings
- Savings presented in this research are limited to hospitals and do not reflect savings to patients or payers

CONCLUSION

- Compared to current SOC, the use of NEPHROCHECK plus SOC facilitates earlier identification and better management of patients at risk of AKI in different hospital settings
- This, in turn, is estimated to result in substantial savings to hospital systems in the form of reductions in uncompensated care, such as extra bed days in ICU and non-ICU settings and 30-day readmissions

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