

# Economic Evaluation of NT-proBNP Testing to Facilitate Prevention of Heart Failure in Adults With Type 2 Diabetes



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## Background

- The American Diabetes Association (ADA) and the American College of Cardiology/American Heart Association (ACC/AHA) recommend N-terminal pro B-type natriuretic peptide (NT-proBNP) testing for early heart failure (HF) detection in patients with diabetes.<sup>1,2</sup>
- Uptake of NT-proBNP testing in the United States (US) has been slow, and payer coverage remains restricted despite guideline recommendations.
- Given the high HF-related hospitalizations and mortality rates in adults ≥ 65 years, broader use of NT-proBNP could improve health and cost impacts in Medicare patients.<sup>3,4</sup>

## Objective

To assess the cost-effectiveness of adding NT-proBNP testing to standard clinical assessments in US Medicare patients ≥ 65 years with type 2 diabetes (T2D) and/or HF risk factors but no HF symptoms.

## Methods

### Study Design

- A decision model using a lifetime time horizon with an annual cycle length was developed to assess the cost-effectiveness of 2 clinical approaches:
  - Standard clinical assessment:** Annual visit where patient management is based on clinical examination (i.e., no NT-proBNP testing).
  - NT-proBNP testing:** Annual visit with NT-proBNP testing to guide patient management. Per clinical guidelines, if NT-proBNP > 125 pg/mL, an echocardiogram is performed to confirm HF.<sup>1</sup>

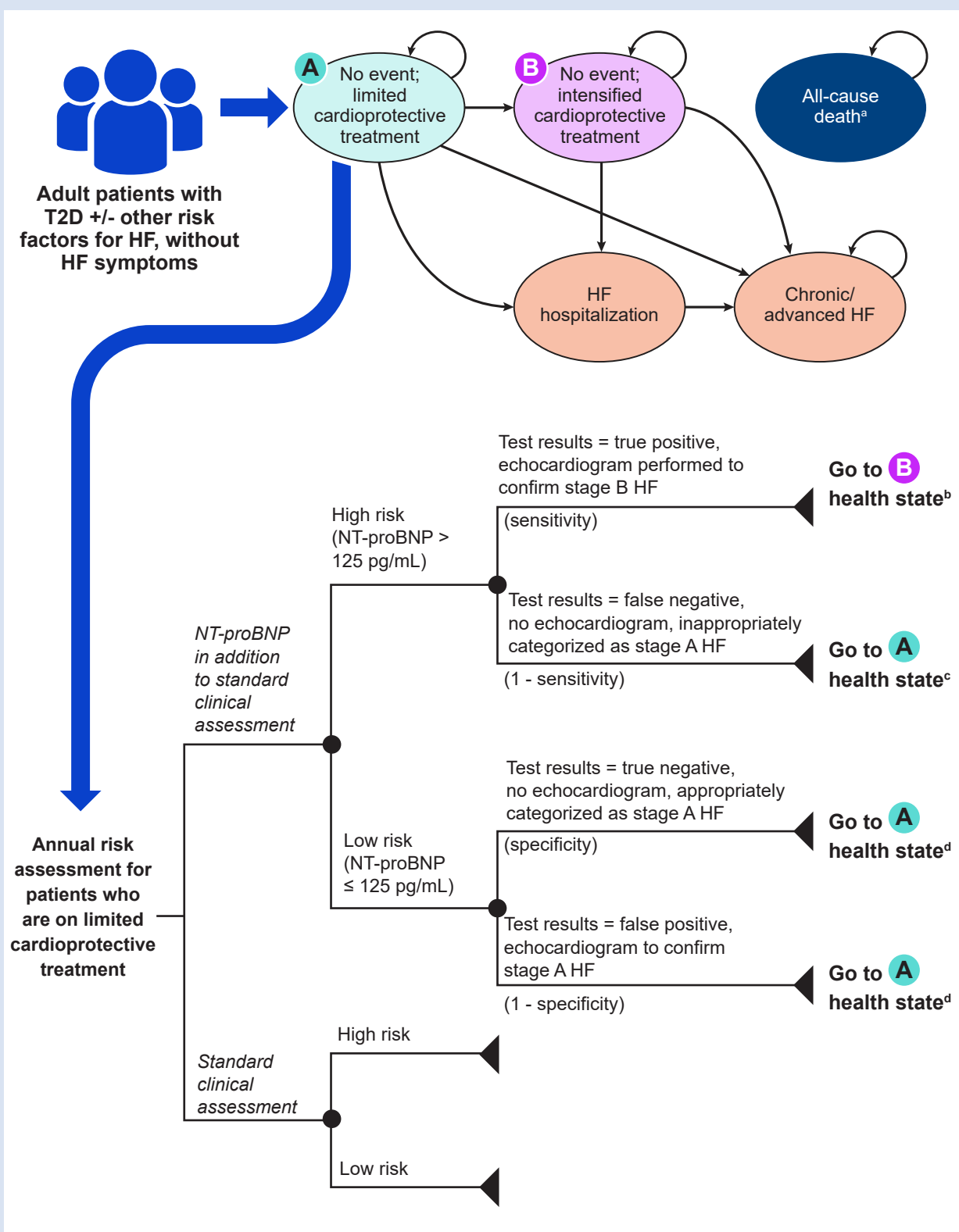
### Health States and Risk Progression

- Patients with either stage A or stage B HF started in the *No event, limited cardioprotective treatment* health state and were assessed annually based on clinical management and risk of HF events (Figure 1).
- High-risk patients (NT-proBNP > 125 pg/mL) moved to the *No event, intensified cardioprotective treatment* health state, increasing their use of cardioprotective treatment.
- Cardioprotective treatment use, including SGLT2is, MRAs, beta-blockers, ARNis, ARBs, and ACEis (Figure 2), reduced HF hospitalization and mortality (Table 1).
- Echocardiogram occurrence was assumed when NT-proBNP exceeded > 125 pg/mL, if a HF event occurred or if a patient was diagnosed with chronic/advanced HF.

### Mortality, Costs, and Utility Weights

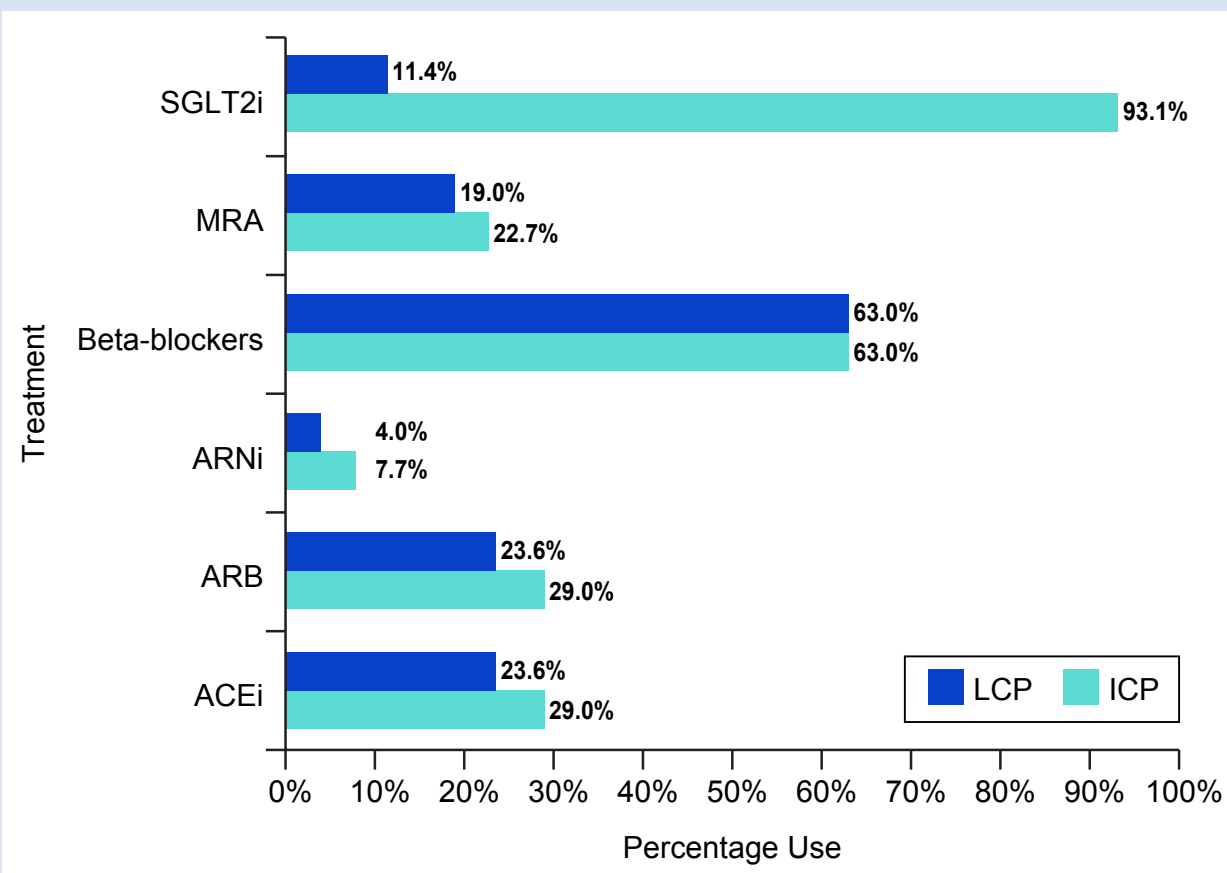
- Age-specific all-cause mortality data were obtained from the US National Vital Statistics.<sup>5</sup> This mortality was adjusted using hazard ratios for T2D, HF, and other causes (Table 1).
- Annual prescription costs for cardioprotective treatment were estimated using costs from Red Book<sup>6</sup> and are presented alongside costs for NT-proBNP, standard clinical assessment, echocardiograms, health states, and utility weights (Table 2).

Figure 1. Model Structure



- <sup>a</sup> Patients can move from any health state to *all-cause death*.
- <sup>b</sup> Patients are at a high risk for HF hospitalizations and progression to chronic/advanced HF. Risk is mitigated by use of intensified cardioprotective treatment.
- <sup>c</sup> These patients are at a high risk for HF hospitalization and progression to chronic/advanced HF with no risk mitigation. Patients stay on limited cardioprotective treatment.
- <sup>d</sup> These patients are at a low risk for HF hospitalization and progression to chronic/advanced HF. Patients stay on limited cardioprotective treatment.

Figure 2. Distribution Among Cardioprotective Treatments



ACEi = angiotensin-converting enzyme inhibitor; ARB = angiotensin (II) receptor blocker; ARNi = renin-angiotensin system inhibition with angiotensin receptor-neprilysin inhibitor; ICP = intensified cardioprotective treatment; LCP = limited cardioprotective treatment; MRA = mineralocorticoid receptor antagonist; SGLT2i = sodium-glucose cotransporter-2 inhibitor.

Table 1. Clinical Parameters

Parameter	Estimate
NT-proBNP testing sensitivity/specificity	90.0/93.0% <sup>7</sup>
Percentage T2D patients at high risk of HF	
Initial year	60.9% <sup>8</sup>
Increase in high-risk patients in subsequent years	2.3% <sup>9</sup>
Annual probability of having an HF hospitalization	
Low-risk patients	0.57% <sup>10</sup>
High-risk patients	2.81% <sup>10</sup>
90-day HF readmission	14.90% <sup>11</sup>
Hazard ratio: Reduction in HF hospitalization given intensified cardioprotective treatment vs. limited cardioprotective treatment	0.51 <sup>10</sup>
Annual probability of progressing to chronic/advanced HF	
Low-risk patients	0.0024 <sup>12</sup>
High-risk patients	0.0143 <sup>12</sup>
Distribution of patients among chronic and advanced HF	
Chronic HF (stage C)	90.2% <sup>13</sup>
Advanced HF (stage D)	9.8% <sup>a</sup>
Annual hospitalization rate	
Chronic HF (stage C)	0.84 <sup>14,15</sup>
Advanced HF (stage D)	2.91 <sup>15</sup>
Hazard ratio: Mortality diabetes vs. no diabetes	1.68 <sup>16</sup>
Hazard ratio: Mortality high risk for HF vs. low risk for HF	2.53 <sup>9</sup>
Hazard ratio: Mortality intensive cardioprotective treatment vs. limited cardioprotective treatment	0.70 <sup>10</sup>
HF hospitalization (inpatient mortality)	3.6% <sup>17</sup>
Annual mortality for patients with chronic HF	4.7% <sup>18</sup>
Annual mortality for patients with advanced HF	49.9% <sup>15</sup>

<sup>a</sup> Calculated.

Table 2. Costs and Utilities

Parameter	Costs	
Risk assessment costs		
NT-proBNP	\$39.26 <sup>19</sup>	
Standard clinical assessment	\$90.87 <sup>20</sup>	
Echocardiogram	\$196.06 <sup>20</sup>	
Cardiologist visit for echocardiogram	\$180.42 <sup>20</sup>	
Health states	Costs	Utilities
Treatment of diabetes without HF (annual, all healthcare costs)	\$17,537.59 <sup>21,22</sup>	0.831 <sup>23</sup>
Hospitalization for HF (event cost)	\$9,424.73 <sup>22,24</sup>	Decrement of 0.105 <sup>25</sup>
Chronic HF (annual cost)	\$43,185.66 <sup>22,26</sup>	0.823 <sup>27</sup>
Advanced HF (annual cost)	\$62,724.97 <sup>22,26</sup>	0.700 <sup>27</sup>

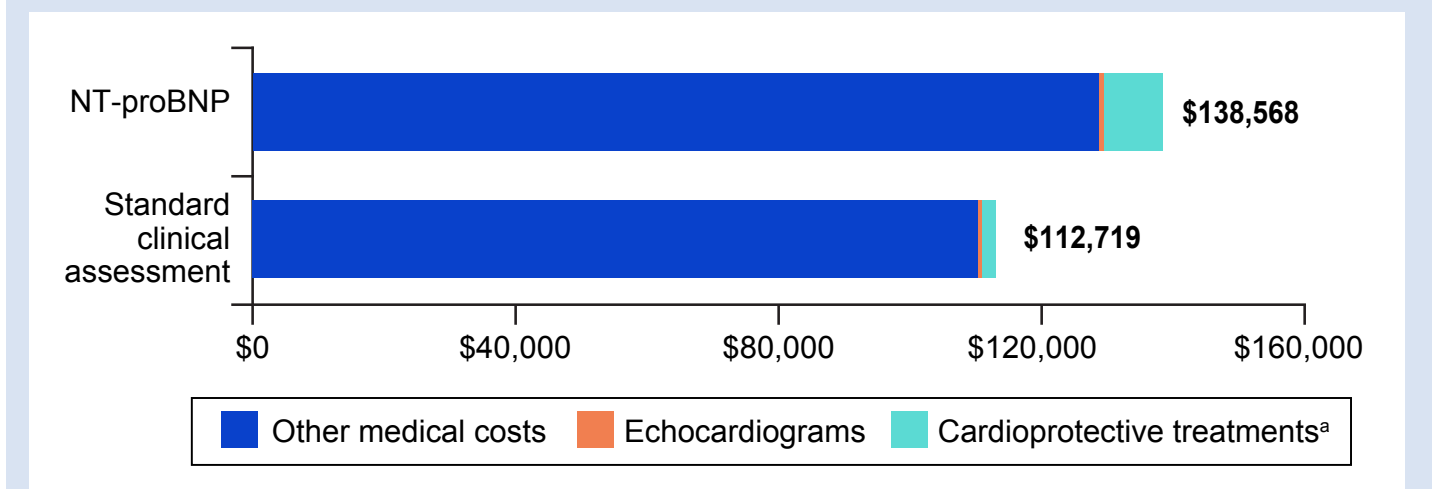
References: Scan QR code at top of poster for a full reference list.

## Results

### Base-Case Results

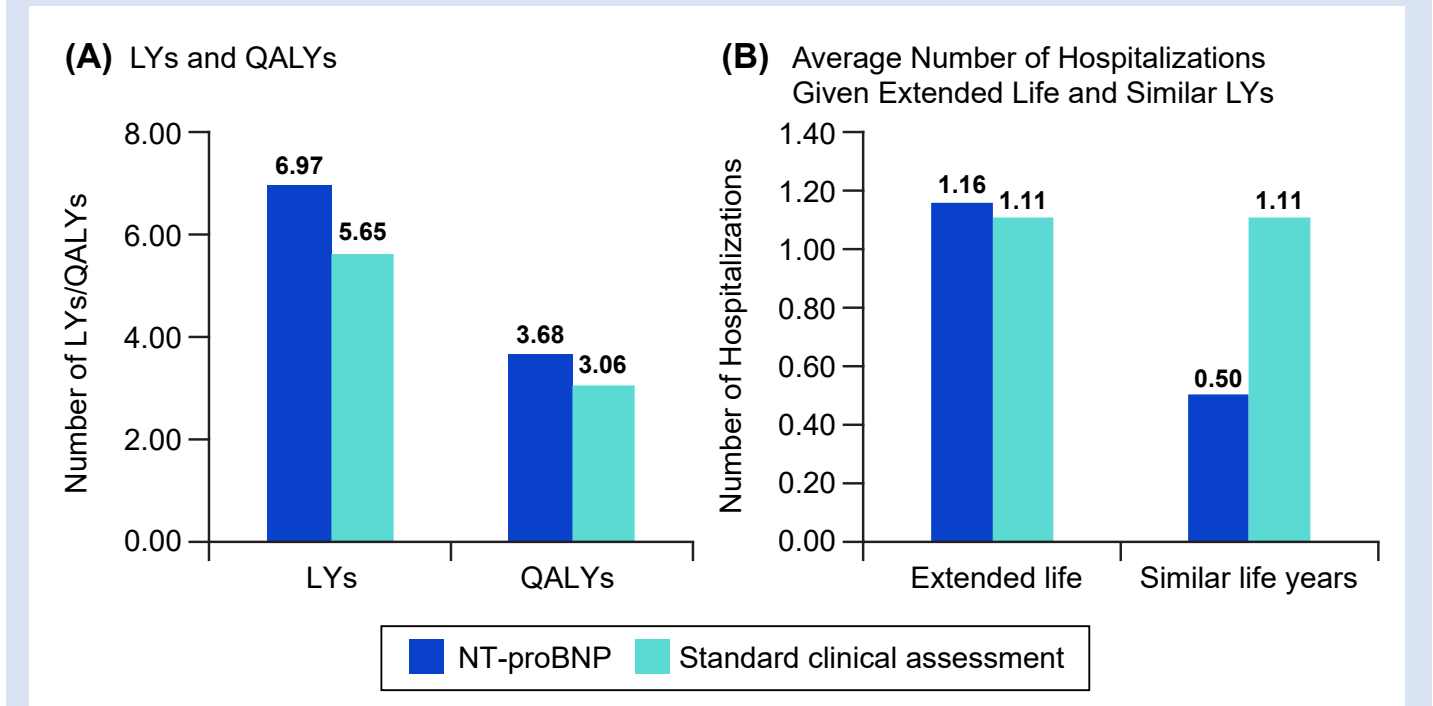
- Lifetime medical costs were higher with NT-proBNP testing (Figure 3). Diagnostic (NT-proBNP testing and echocardiograms) and cardioprotective treatment costs were a small proportion of a patient's overall costs.
- Testing with NT-proBNP increased the number of echocardiograms and HF hospitalizations, which was attributed to extended patient survival (Figure 4).
- Adding NT-proBNP testing to standard, annual clinical assessment is cost-effective (< \$50,000 willingness-to-pay threshold), with an incremental cost per quality-adjusted life-year (QALY) gained of \$41,930, and would be cost-saving if life-years (LYs) for those receiving NT-ProBNP were not extended.

Figure 3. Lifetime Medical Costs



Note: Costs are discounted at 3% per annum.  
<sup>a</sup> Cardioprotective treatment costs estimated using dosing information and wholesale acquisition costs obtained from Red Book (no discounts, copays, or rebates were applied).

Figure 4. LYs, QALYs, and Average Number of Hospitalizations Given Extended Life and Similar LYs



Note: QALYs are discounted at 3% per annum.

### Sensitivity Analysis

- One-way sensitivity analyses suggest that results were most sensitive to:
  - Annual cost of treating patients with T2D who do not have HF
  - SGLT2i effectiveness in reducing HF hospitalizations
  - Mortality rate in high-risk HF patients
- Probabilistic sensitivity analysis indicated that NT-proBNP testing was cost-effective in 80.4% of simulations.

## Conclusions

- A decision model assessed the cost-effectiveness of including NT-proBNP testing within standard clinical assessments in a US Medicare population with T2D and/or HF risk factors.
- The inclusion of NT-proBNP testing raised direct costs but led to a reduction in LY-adjusted hospitalizations, prolonged patient survival, and increased quality of life.
- NT-proBNP testing is cost-effective relative to standard clinical assessment alone in 80.4% of cases, supporting the guideline-directed routine use in early HF risk assessment.