Estimated Cost Effectiveness for Inpatient Anesthesia Services in Massachusetts

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Purpose: The purpose of this report is to illustrate the cost effectiveness of CRNAs for inpatient anesthesia services in Massachusetts. This analysis adapted a previously published method to simulate cost effectiveness for anesthesia services and applies new data and more recently published research results.

Introduction: Certified Registered Nurse Anesthetists (CRNAs) work in a variety of anesthesia delivery models. There are no laws or regulations in Massachusetts that require physician supervision of CRNA practice. Additionally, there are 22 states (24 as of July 2023) that have opted-out of the Centers for Medicare & Medicaid Services (CMS) Condition of Participation (CoP) federal physician supervision rule.[1] Massachusetts has not opted-out but is eligible to do so. There are currently more CRNAs working in the state of Massachusetts than physician anesthesiologists. According to the Medicare Physician Compare, there are a total of 1,313 (57%) CRNAs and 1,003 (43%) anesthesiologists practicing in the state.[2]

Methodology: According to Hogan et al., a stochastic simulation model "simulates likely costs and revenues associated with each delivery model, holding constant other conditions likely to affect costs and revenues in the comparisons".[3] This analysis implemented variables related to average inpatient procedures as found in the 2016 Lewin study[4], current state or region-specific conversion factors for commercial contracts[5], and references hospital payer mix proportions and salary factors applicable to Massachusetts for revenue and cost[6].

Results are presented simulating the potential revenue and cost for a variety of defined anesthesia delivery models for Massachusetts acute care hospitals but does not consider weeks not working (i.e., paid time off, holiday, vacation, and sick time). Therefore, an additional method to account for actual staffing needs to *sustain* a 12 operating room facility when anesthesia providers take their paid time off (i.e., non-working days) was implemented. Estimates for time off were based on a 2019 survey of CRNAs[7] and assumed equivalent for both types of providers. Additional analysis incorporates the additional staff and related costs when accounting for paid time off for all providers.

Table 1. Key Parameters Are Held Constant in Simulation

Reimbursement Mix	Payer Proportions [a]	Conversion Factors
Medicare [b]	0.44	21.56
Medicaid	0.18	18.86
Private [c]	0.38	89.00
Other	0.00	0.00
Anesthesia Billing per Procedure [d]	**Ave Base Units**	**Ave Time Units**
	6.0	8.3
Facility Productivity	**Daily Procedures per OR**	**Annual Procedure Days**
	4	260
Anesthesia Provider Salary [e]	**Anesthesiologist**	**CRNA**
	$445,000	$218,000

[a] Payer proportion was identified using Center for Health Information Analysis, Massachusetts Hospital Profiles, Data Through Fiscal Year 2020.[7] http://www.chiamass.gov/assets/docs/r/hospital-profiles. Other is equivalent to the self-pay group found in the *Nursing Economic$* study and is assumed to be non-revenue producers (i.e., unreimbursed) and is represented as contributing no revenue.

[b] State-specific Medicare 2022 conversion factor.

[c] State-specific median from Stead, S.W. and Merrick, S.K. ASA Survey Results for Commercial Fees Paid for Anesthesia Services – 2021. ASA Monitor 81(10) p64-71.

[d] The Lewin Group(2016). Update of Cost Effectiveness of Anesthesia Providers. Lewin Publications, May 13, 2016. http://www.lewin.com/content/dam/Lewin/Resources/AANA-CEA-May2016.pdf

[e] Salary.com state-specific estimates.

Results: Table 1 summarizes the key parameters held constant in this simulation. Anesthesia revenue was calculated using the Medicare billing rules for anesthesia based on anesthesia base and time units multiplied by anesthesia conversion factor. Inpatient demand has been defined as four anesthetics per inpatient operating room, and 12 inpatient operating rooms per facility.[4] Additionally, annual revenue calculations excluded weekend days (i.e., 104 days) within the year to represent average procedure days. Finally, Hogan and colleagues used anesthesia salary to derive anesthesia cost[4] and we used the same approach in this analysis.

Table 2 presents the simulated demand for an acute care hospital in Massachusetts and the revenue and costs associated with providing anesthesia services according to anesthesia delivery model for operating rooms only. When assessing profit per operating room, the model assumes average operating room volume (i.e., procedure per operating room) and payer mix are similar throughout Massachusetts for any given inpatient operating room. When all parameters are held constant, the most cost-effective anesthesia delivery model is the CRNA only model. The second most cost-effective model is the medical direction 1:4 model. In this case, more anesthesia providers (e.g., 3 anesthesiologists and 12 CRNAs) would be needed to achieve the same production as the CRNA only model (e.g., 12 CRNAs), resulting in a profit reduction.

The impact of additional staffing resources necessary to *sustain* anesthesia services for a 12 operating room facility is displayed in Table 3. Trends are similar to Table 2; however, the cost of additional staff results in negative revenue for higher cost models including the 1:2 Medical Direction and MDA Only models.

Table 2. Estimated Net Revenue per Hospital / OR

Anesthesia Delivery Model based on four procedures per OR	Example of staffing ratios	Annual Total Revenue per Hospital	Annual Total Costs per Hospital	Net Revenue (Revenue-Cost) per Hospital	Net Revenue (Revenue-Cost) per OR
CRNA only	12 CRNAs	$8,334,483	$2,616,000	$5,718,483	$476,540
MDA only	12 MDs	$8,334,483	$5,340,000	$2,994,483	$249,540
Medical Direction 1:4	3 MDs/12 CRNAs	$8,334,483	$3,951,000	$4,383,483	$365,290
Medical Direction 1:2	6 MDs/12 CRNAs	$8,334,483	$5,286,000	$3,048,483	$254,040
Supervision 1:6	2 MDs/12CRNAs	$6,498,565	$3,506,000	$2,992,565	$249,380

Note: As in the 2010 *Nursing Economic$* simulation[4], we assume an inpatient hospital has 12 operating rooms that perform 4 procedures a day using one of the defined anesthesia delivery models above. Annual total revenue excludes weekends (i.e., 260 procedure days). When assessing savings per operating room, model assumes average operating room volume (i.e., procedure per operating room) is similar throughout state for any given inpatient operating room.

Table 3. Estimated Net Revenue per Hospital / OR Including Paid Time Off

Anesthesia Delivery Model based on four procedures per OR	Number of Staff Needed to Sustain Anesthesia Services for 12 ORs*	Annual Total Revenue per Hospital	Annual Total Costs per Hospital	Net Revenue (Revenue-Cost) per Hospital	Net Revenue (Revenue-Cost) per OR
CRNA only	13.6 CRNAs	$8,334,483	$2,964,800	$5,369,683	$447,474
MDA only	13.6 MDs	$8,334,483	$6,052,000	$2,282,483	$190,207
Medical Direction 1:4	3.4MD/13.6CRNA	$8,334,483	$4,477,800	$3,856,683	$321,390
Medical Direction 1:2	6.8MD/13.6CRNA	$8,334,483	$5,990,800	$2,343,683	$195,307
Supervision 1:6 **	2.3MD/13.6CRNA	$6,498,565	$3,988,300	$2,510,265	$209,189

*According to a study by Negrusa et al., "Work patterns, socio-demographic characteristics and job satisfaction of the CRNA workforce – Findings from the 2019 AANA survey of CRNAs", published in Nursing Outlook in 2021, the median weeks worked per year was approximately 45. Paid time off is represented as 7 weeks of not working per year for both provider types.

** Assumes 4 base units for supervising MDA

Limitation: This analysis is unable to account for differences in either revenue or cost for hospitals that vary in number of operating rooms, anesthesia provider employment arrangement (i.e., hospital contracted or employed), work hours, fringe benefits, stipends, payer mix, mixed provider models, procedures, and/or billing practices.

Conclusion: Based on this analysis, the most cost-effective anesthesia delivery model is achieved when CRNAs deliver anesthesia services alone.

References

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