

# Closed Incision Negative Pressure Therapy Management Versus Standard of Care Over Closed Incisions in the Reduction of Surgical Site Complications: A Systematic Review and Meta-Analysis of Comparative Studies

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## Background

- Surgical site complications (SSCs), such as surgical site infection (SSI), dehiscence, seroma, hematoma, and skin necrosis, can negatively affect patient outcomes and health care costs.
- Surgical site management options, including closed incision negative pressure therapy (ciNPT\*), have been developed to help mitigate the risk of SSC development.
- ciNPT use has been associated with positive patient outcomes across many surgical specialties.<sup>1-6</sup>

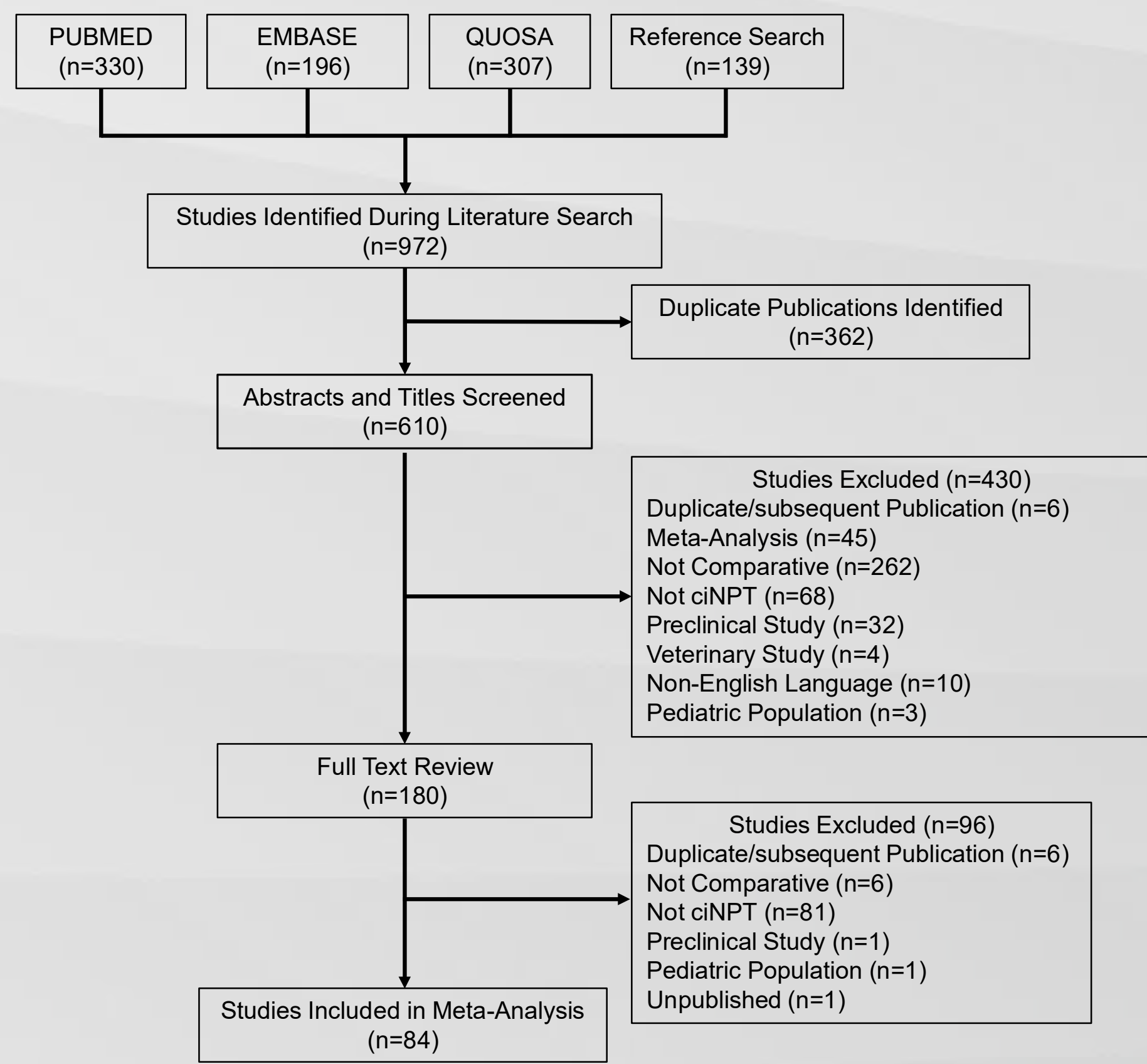
## Purpose

- This systematic review and meta-analysis evaluated the effect of ciNPT on post-surgical and health economic outcomes across published studies.

## Methods

- A systematic literature search using PubMed, EMBASE, and QUOSA was performed (**Figure 1**).
- Publications written in English, comparing ciNPT to standard of care dressings (SOC) between January 2005 and August 2021 were assessed.

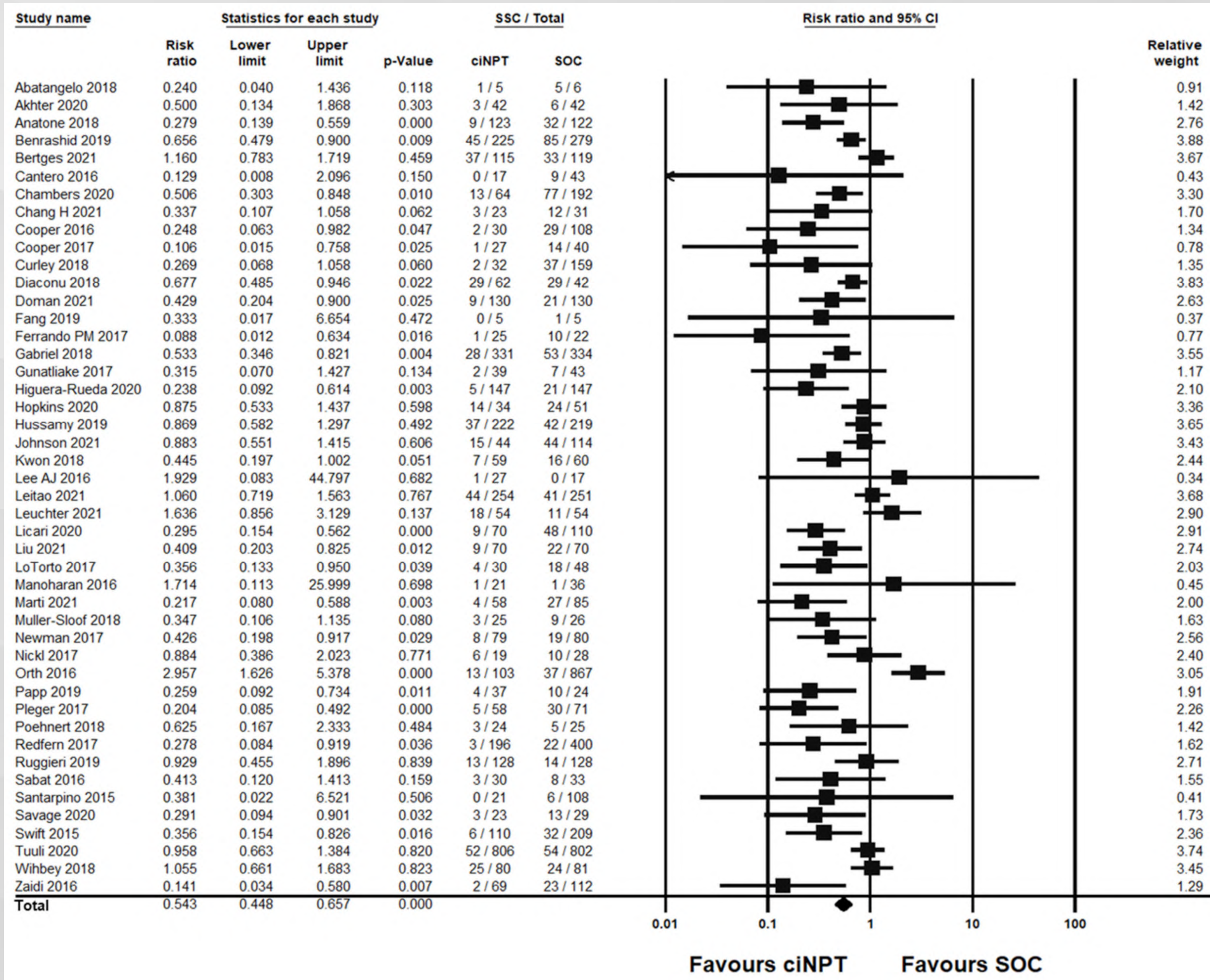
- Characteristics of study participants, surgical procedure, dressing used, duration of treatment, post-surgical outcomes, and follow-up data were extracted.
- Mean differences or standardized mean differences were used to assess continuous variables reported on the same scale or outcomes reported on different scales/measurement instruments.



**Figure 1.** Identification of studies for meta-analysis.

## Results

- The literature search identified 84 studies for analysis.
- Significant reductions in SSC rates in favor of ciNPT use were found (p<0.05, **Figure 2**).



**Figure 2.** Surgical site complication forest plot. Each study is displayed with the risk ratio, upper and lower limit, total number of events, and relative weight. The total represents the overall weighted risk ratio and limits using a random effects model.

- Significant reductions in SSI, superficial SSI, deep SSI, seroma, dehiscence, and skin necrosis were associated with ciNPT use (p<0.05, **Table 1**).
- Reduced readmission and reoperations were significant in favor of ciNPT (p<0.05, **Table 2**).
- ciNPT patients had a 0.9 day shorter hospital stay than patients receiving SOC (p<0.001, **Table 2**).

## Results (Cont'd)

- Differences in post-operative pain scores and reported amounts of opioid usage were significant in favor of ciNPT use (p<0.05, **Table 3**).
- While post-operative drainage and antibiotic usage were reduced in ciNPT patients, it was not significant (p>0.05, **Table 3**).

**Table 1.** Summary of surgical site complication meta-analyses.

Complication	Studies (n)	Risk Ratio (95% CI)	I <sup>2</sup>	Relative Risk Reduction (LL, UL)	p-value
SSC	46	0.543 (0.448, 0.657)	64.884	46% (34%, 55%)	<0.001
SSI	65	0.524 (0.438, 0.628)	56.110	48% (37%, 56%)	<0.001
SSSI	20	0.523 (0.373, 0.733)	43.047	48% (27%, 63%)	<0.001
DSSI	22	0.472 (0.289, 0.770)	19.920	52% (23%, 71%)	0.003
Seroma	27	0.676 (0.519, 0.881)	27.91	32% (12%, 48%)	0.004
Hematoma	22	0.728 (0.457, 1.159)	0.000	27% (-16%, 54%)	0.180
Dehiscence	39	0.623 (0.424, 0.913)	65.079	38% (9%, 58%)	0.015
Skin Necrosis	10	0.465 (0.301, 0.718)	0.000	54% (28%, 70%)	0.001

CI= Confidence interval; DSSI= Deep surgical site infection; LL= Lower limit; SSC= Surgical site complication; SSI= Surgical site infection; SSSI= Superficial surgical site infection; UL= Upper limit

**Table 2.** Summary of health economic outcomes meta-analyses.

Outcome	Studies (n)	Statistic (LL, UL)	I <sup>2</sup>	p-value
Readmission	24	Risk Ratio 0.773 (0.606, 0.987)	24.453	0.039
ROR	40	Risk Ratio 0.64 (0.519, 0.789)	12.271	<0.001
LOS	25	Difference in Means -0.901 (-1.257, -0.544)	80.458	<0.001

LL= Lower limit; LOS= Length of stay; ROR= Return to operating room; UL= Upper limit

## Results (Cont'd)

**Table 3.** Summary of miscellaneous patient outcomes meta-analyses.

Outcome	Studies (n)	Statistic (LL, UL)	I <sup>2</sup>	p-value
Drainage (mL)	6	Difference in Means -122.8 (-253.2, 7.7)	83.4	0.065
Antibiotics	9	Risk Ratio 0.697 (0.484, 1.005)	68.811	0.053
Pain Score	3	Standard Difference in Means -0.499 (-0.668, -0.331)	0	<0.001
Opioid Use (mg)	2	Difference in Means -20.098 (-35.198, -4.999)	0	0.009

LL= Lower limit; UL= Upper limit

## Conclusions

- For these meta-analyses, the use of ciNPT was associated with a statistically significant reduction in the incidence of SSCs, SSIs, seroma, dehiscence, and skin necrosis.
- Reduced readmission, reoperations, and length of hospital stay were also observed in ciNPT patients as well as decreased pain and opioid use.
- Study limitations include mix of observational studies and randomized controlled trials, a mix of surgical specialties, and differences in data reporting across the included articles.
- It should be noted that the data are related to one commercially available ciNPT system and may not be applicable to other available systems due to differences in the devices.
- Surgeons should consider all available data before considering whether or not to use a particular ciNPT device.

## References

1. Cooper HJ, Roc GC, Bas MA, et al. *Injury*. 218;49(2):386-391.
2. Ruggieri VG, Olivier ME, Aludaat C, et al. *Heart Surg Forum*. 2019;22(2):E092-E096.
3. Licari L, Campanella S, Carolla C, et al. *Cureus*. 2020;12(5):e8283.
4. Swift SH, Zimmerman MB, Hardy-Fairbanks AJ. *J Reprod Med*. 2015;60(5-6): 211-218.
5. Ferrando PM, Ala A, Bussone R, et al. *Plast Reconstr Surg Glob Open*. 2018;6(6):e1732
6. Pleger SP, Nink N, Elzien M, et al. *Int Wound J*. 2018;15(1):75-83.

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\*3M™ Prevena™ Incision Management System (3M, St. Paul, MN)

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