Surgical Precision: A New Standard of Care to Combat Infection and Resistance

How Targeted Delivery Against the Endogenous Microbiome is Revolutionizing Surgical Prophylaxis

BINARY

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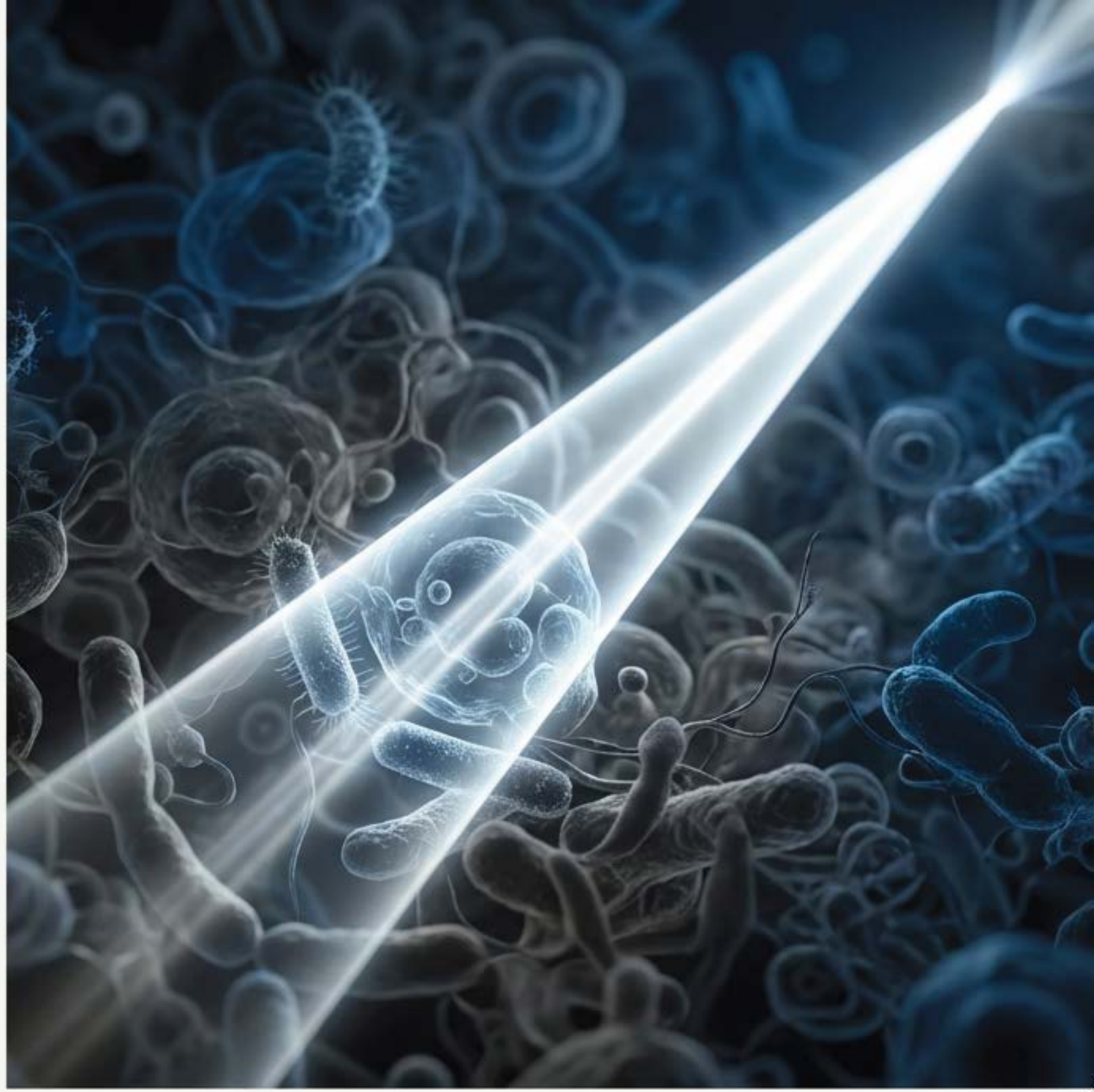


The Current Standard of Care Has Unacceptable Collateral Damage

Surgical Site Infections (SSIs) are the third most common nosocomial infection, affecting up to 11% of general surgical patients globally. They represent a primary driver of antibiotic use, fueling the global antimicrobial resistance (AMR) crisis. The financial and human costs are staggering.

$25,000+

The estimated average cost of a single SSI, increasing to over $90,000 for complex infections like deep sternal wounds after cardiac surgery.

2.0 Days

The median increase in hospital length of stay for a patient with an SSI after a cesarean section.

Up to 60%

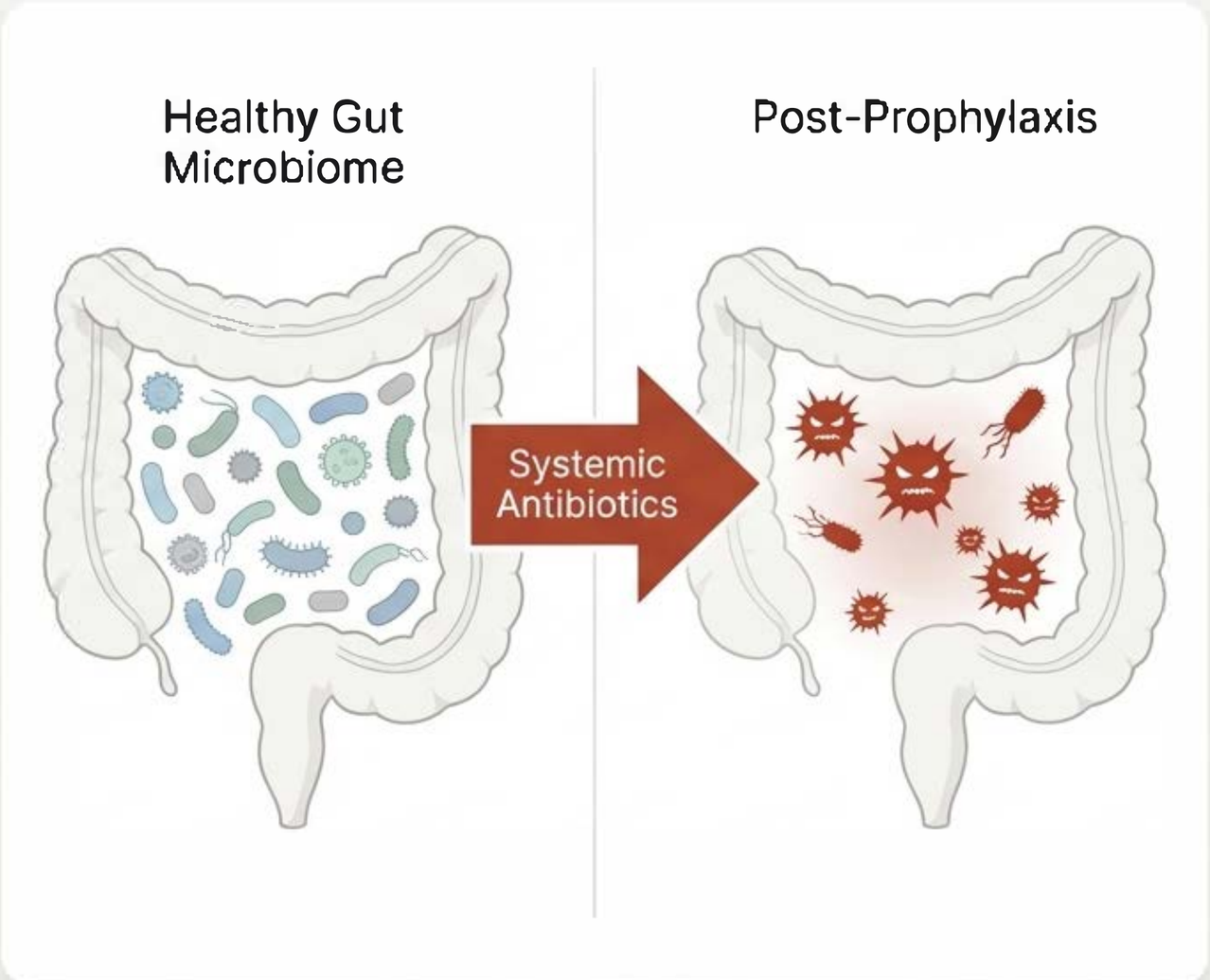
The proportion of SSIs that are potentially preventable.

The Paradox of Prophylaxis: How a Preventative Measure Can Cause a Deadlier Infection

Systemic, broad-spectrum antibiotic prophylaxis—our primary preventative tool—can devastate the patient's gut microbiota. This creates an opening for opportunistic pathogens like ***Clostridium difficile*** (CDI) to thrive, leading to severe colitis and even death.

During one outbreak, the risk of developing CDI after surgical prophylaxis skyrocketed from **0.7 to 14.9 cases per 1,000 procedures**—a >20-fold increase.

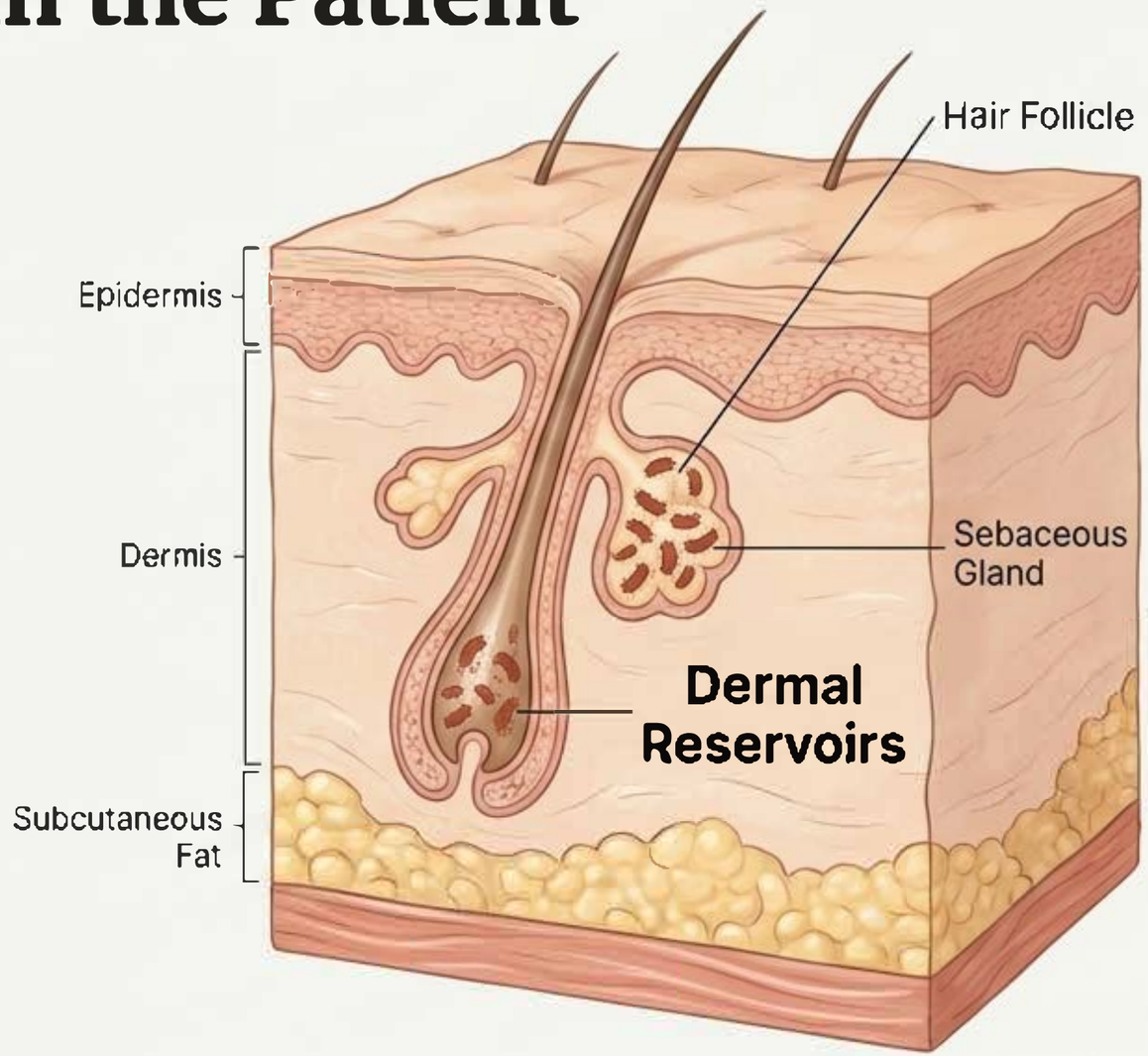
CDI adds an estimated **$9,016** in hospital costs and **6.4 extra days** of stay per patient.



A New Understanding: The True Source of Infection is Already Within the Patient

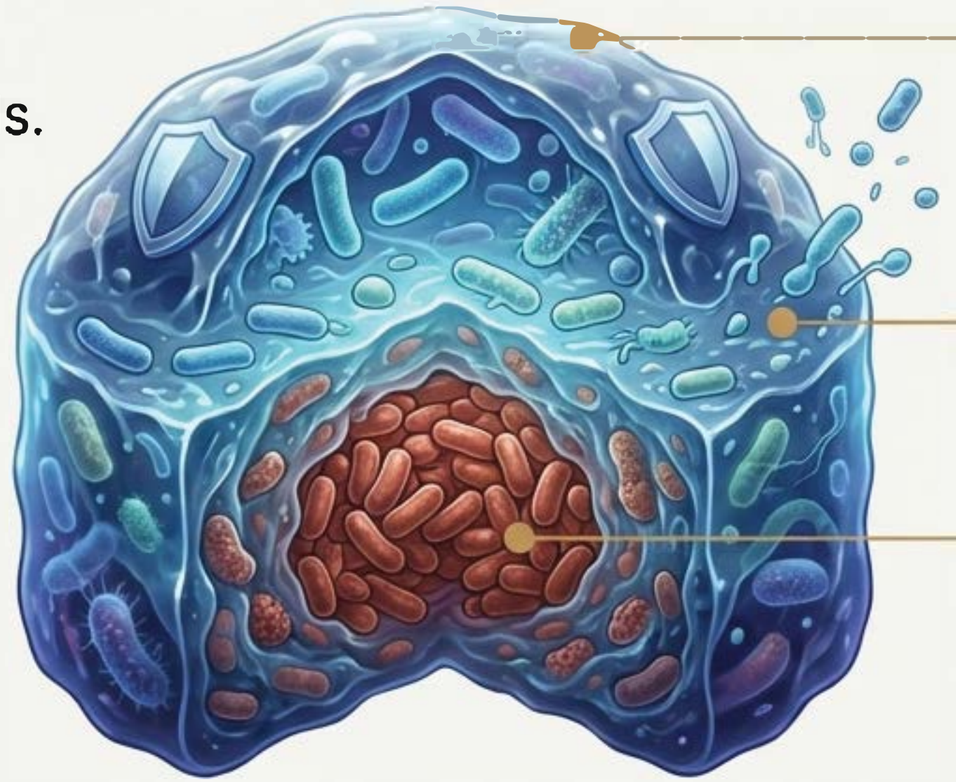
Molecular studies have overturned the traditional model of surgical infection. The vast majority of SSIs are not caused by external contaminants entering the wound, but by the patient's own endogenous flora.

- **70%–95%** of SSIs originate from the patient's own bacteria residing deep within the dermal and adnexal structures, such as hair follicles and sebaceous glands.
- Genomic tracking studies confirm that in upwards of **80%** of *S. aureus* SSIs, the infecting strain is identical to one colonizing the patient preoperatively.



Microbial Fortresses: Why Systemic Antibiotics Can’t Penetrate the Biofilm

Bacteria at the surgical site don’t exist as free-floating cells. They form highly organized communities called biofilms, which act as a shield against both the immune system and systemic antibiotics.



Protective Shield: An outer matrix of extra-cellular polymeric substances (EPS) physically blocks antibiotic penetration and immune cells.

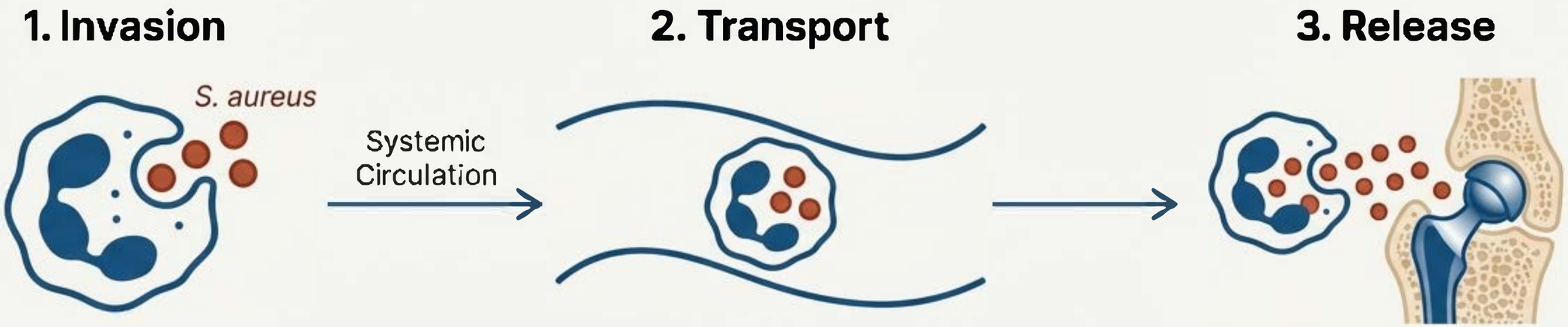
Active Outer Layer: Constantly sheds “planktonic” bacteria to colonize new areas.

Dormant Inner Layer: “Persister cells“ with low metabolic activity survive antibiotic waves and reactivate post-treatment, causing relapse.

Eradicating an established biofilm requires bactericidal concentrations at the source—levels that are often impossible or toxic to achieve with systemic IV administration but can be acheived by intradermal administration.

The Trojan Horse Hypothesis: How Distant Bacteria Infiltrate the Surgical Site

Pathogens can seed a sterile operative site from anatomically distant locations. This mechanism explains how bacteria from the **gut or nares** can cause an infection in an orthopedic implant.



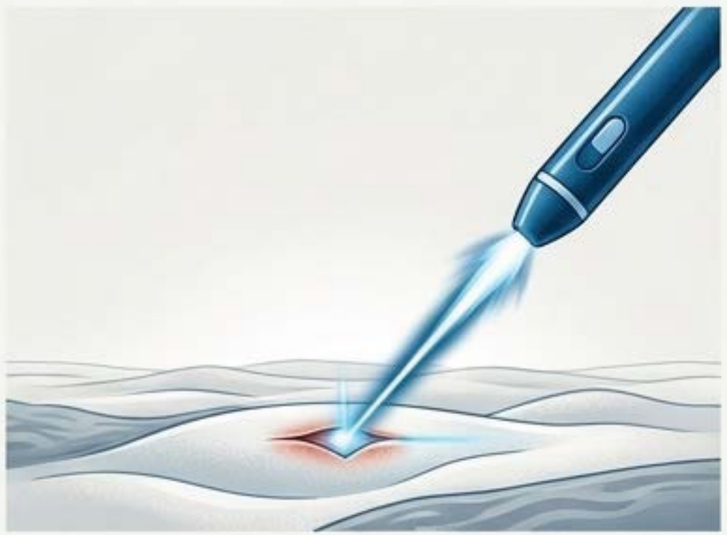
"This phenomenon re-characterizes modern surgical infection as a 'failure to control the host-microbiome during surgery.'"

The Solution: High Concentration at the Source, Minimal Systemic Exposure

Systemic Prophylaxis

Targeted, local antibiotic delivery resolves the paradox of prophylaxis. By delivering the drug directly into the incision, it achieves bactericidal concentrations far exceeding the Minimum Inhibitory Concentration (MIC) where it's needed most, while keeping systemic levels negligible.

Intradermal Delivery



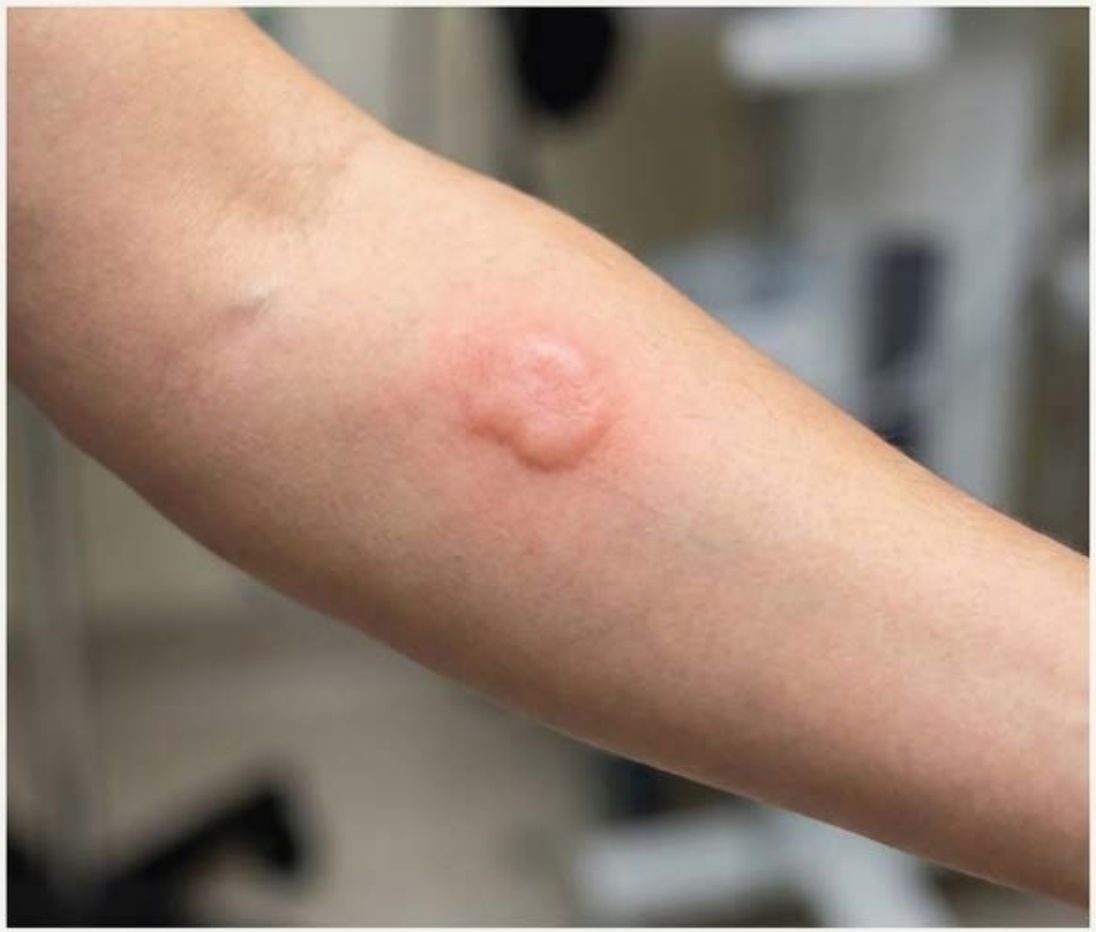
>90% Reduction

in systemic antibiotic consumption, directly combating AMR and preserving the patient's microbiome.

A Century of Precedent: The Principle of Intradermal Delivery is Already Mastered

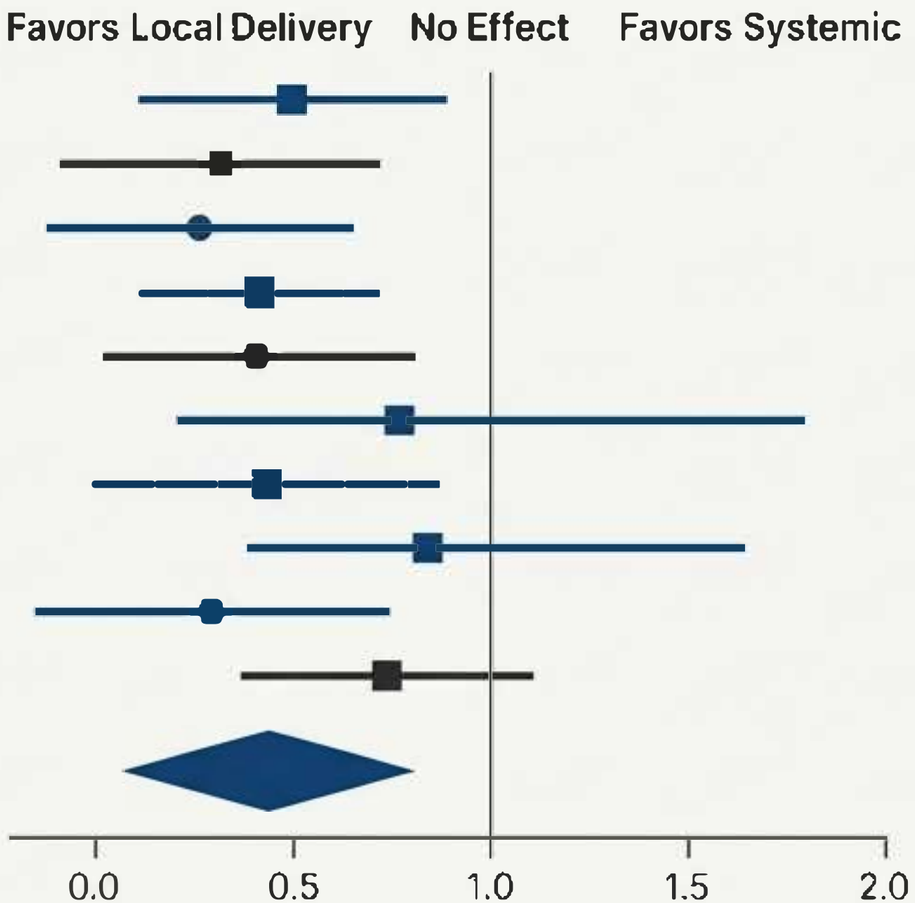
The concept of precise, low-volume delivery directly into the dermal layers is not novel. For over 100 years, the Mantoux Tuberculin Skin Test (TST) has relied on the same principle: a standardized intradermal injection that produces a localized, measurable response.

Key Concept: This trusted technique demonstrates that the skin can serve as a reliable site for targeted immunologic or therapeutic intervention. Intradermal microdosing applies this proven principle to antibiotic prophylaxis.



The Evidence is Conclusive: Local Delivery Overwhelmingly Reduces Surgical Site Infections

A 2024 meta-analysis published in *Nature Scientific Reports* synthesized data from 13 randomized controlled trials including 7,719 patients. The findings confirm the definitive superiority of Regional Antibiotic Delivery (RAD).



>50%

REDUCTION in SSI Odds

(Odds Ratio **0.48**; 95% Confidence Interval [0.35, 0.66]; $P < 0.001$)

The benefit is consistent across different antibiotics (vancomycin and gentamicin) and high-risk patient populations, including those with diabetes.

A Tailored Approach: Matching the Agent and Delivery System to the Anatomy

The optimal strategy for local prophylaxis depends on the unique endogenous flora and surgical context of the anatomical site.

Dermatology & Plastics (Skin)

- **Targets:** *S. aureus*, *C. acnes*
- **Agents:** Clindamycin, Cephalosporins
- **Method:** Intra-incisional Intradermal Microdosing

Orthopedics (Joints & Fractures)

- **Targets:** *S. aureus*, *S. epidermidis*, Gram-negatives
- **Agents:** Gentamicin, Tobramycin
- **Method:** Antibiotic-Loaded Bone Cement (ALBC), Biodegradable Beads

Spinal Surgery (Spine)

- **Targets:** MRSA, *C. acnes*
- **Agents:** Vancomycin
- **Method:** Intrawound Powder Application

General & Abdominal (Gut & Skin Flora)

- **Targets:** Enteric Gram-negatives, Skin Flora
- **Agents:** Cephalosporins
- **Method:** Intra-incisional Intradermal infiltration, Wound Irrigation

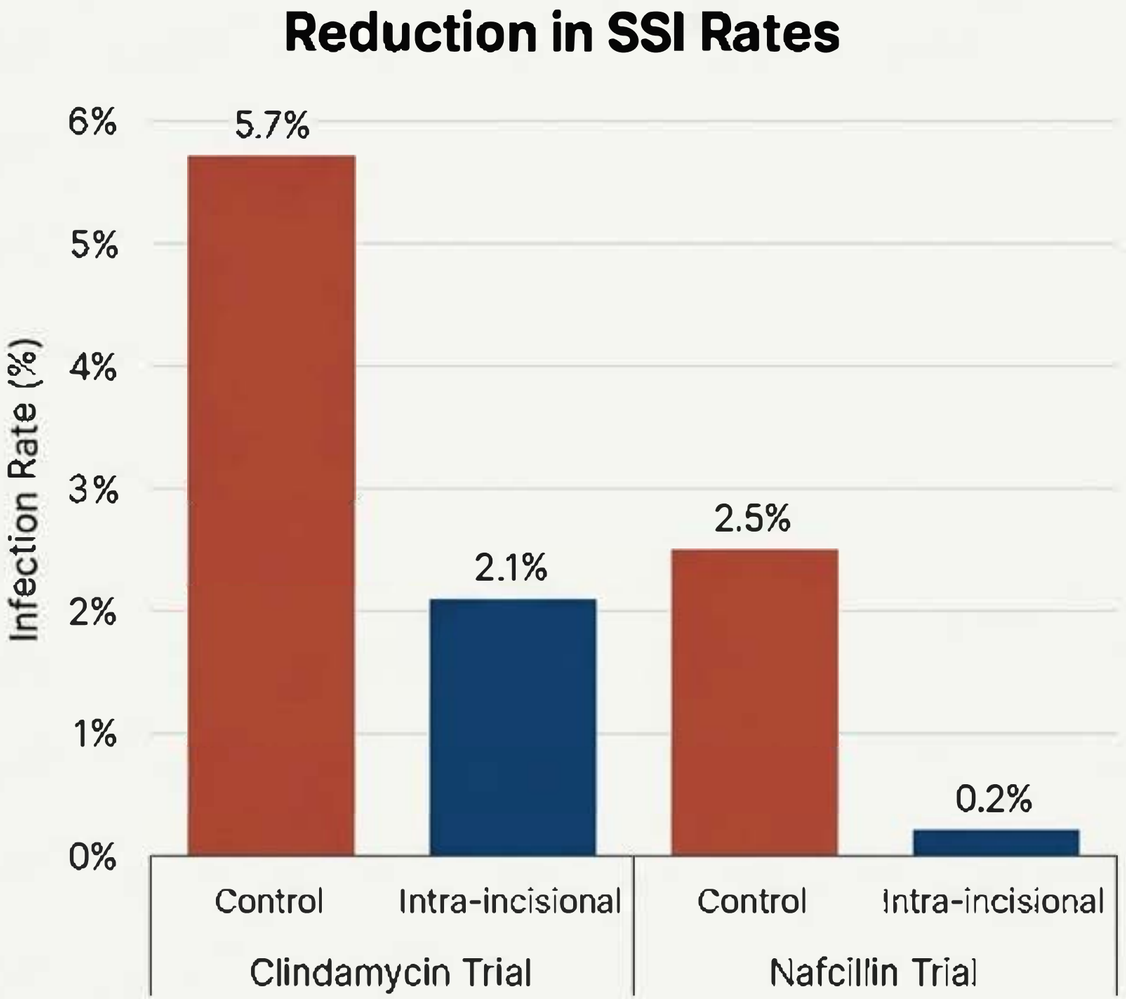
Case Study: Precision Prophylaxis in Dermatologic Surgery

In cutaneous and soft tissue procedures, the primary threat is Gram-positive cocci and *Cutibacterium acnes* residing in the deep dermis. Intra-incisional microdosing delivers the antibiotic directly into this dermal interstitial reservoir.

Clinical Trial Evidence

Intra-incisional Clindamycin (500 µg/mL): Significantly reduced SSI rates in skin cancer surgery from **5.7%** in controls to **2.1%**.

Intra-incisional Nafcillin: Reduced infection rates in dermatologic surgery from **2.5%** to just **0.2%**.



Making the Proven Practice the Standard Practice

Decades of evidence support this paradigm shift. It is time to align clinical standards and policy with the data to improve patient safety and combat antimicrobial resistance.

For Professional Societies & Guideline Committees

Action: Update clinical practice guidelines to reflect the evidence supporting intradermal and local prophylaxis for relevant surgical procedures.

Rationale: Align recommendations with the highest level of evidence to drive change.

For Healthcare Systems & Hospitals

Action: Incorporate local prophylaxis as a key metric for antibiotic stewardship programs and quality improvement initiatives.

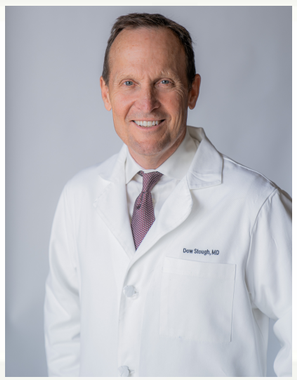
Rationale: Reduce SSI rates, lower costs, and demonstrate leadership in combating AMR.

For Policy Makers & Payers

Action: Incentivize the adoption of evidence-based local prophylaxis through quality payment programs and updated reimbursement models.

Rationale: Drive system-wide adoption of a higher-value, lower-risk standard of care.

Guided by Leaders in Surgery, Infectious Disease, and Pharmaceutical Development



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