

Onsite Hypochlorous Acid in Hospitals: Cutting Disinfection Cost Without Compromising Compliance

Logistics, cost, the evidence, and the compliance guardrails. Written for hospital leadership, infection prevention and environmental services. October 2026, revision 1.

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What this paper claims, and what it does not

An EcoloxTech system is a device that produces a hypochlorous acid solution on site. It is regulated by the EPA as a device, and we make no efficacy claims for it or for the solution it produces.

Laboratory and published findings are reported as findings about hypochlorous acid under the conditions stated, attributed to the laboratory that produced them.

Documented disinfection claims come from HOCl-AS200 (EPA Reg. No. 101112-1) used according to its label, and from nowhere else.

Cost figures are labelled by source: EcoloxTech list and contract prices, a published per-room estimate of hospital spend, and an illustrative model, each with its assumptions shown. None is a measured result from a hospital. We do not claim that our equipment prevents healthcare-associated infections, and the section on what it does not fix sets out its limits.

Executive summary

In an illustrative model of a 300-bed hospital, total disinfection spend falls by roughly 40% over 12–18 months without reducing cleaning frequency, shortening contact times, or dropping a required pathogen claim. The savings come from waste, not coverage: overlapping products, mis-diluted and expired chemistry, unproductive labor minutes, single-use items, and rework after failed cleans. Onsite hypochlorous acid generation addresses two of those directly — running out and mis-diluting — and simplifies the rest.

The model rests on five levers:

1. **Product rationalization** — collapsing 15–30 disinfectant SKUs into a short formulary built around a registered product used to its label.

- 2. **Onsite generation** — producing hypochlorous acid at a set concentration on site, in place of delivered ready-to-use bottles and hand-mixed buckets.
- 3. **Workflow and labor redesign** — standardized room sequences, task-based staffing, and fewer wasted trips.
- 4. **Targeted technology** — tracking and adjunct systems used where they reduce labor or rework, not as add-ons.
- 5. **Reusables and reprocessing** — laundered microfiber in place of cotton cloths, string mops and some pre-saturated wipes.

Compliance is protected by one rule: every change is validated by objective cleaning measurement (fluorescent marker and ATP audits) before and after rollout, and infection prevention holds a veto at each phase. The 40% figure is a model, not a promise; hospitals that have already standardized will see smaller gains, and the free sanitation audit applies the same analysis to a specific site.

For hospital groups, EcoloxTech offers HOCl-AS200 under contract at \$5.95 a gallon in 275-gallon totes. Paired with an E-300 at each hospital for the work that needs no registered claim, a five-hospital group with a quarter of its volume on AS200 saves about \$124,000 a year against ready-to-use spray, and the combination costs less than bleach-derivative wipes at any split. The cost analysis sets out the terms, the volumes and the break-even.

Where disinfection money actually goes

Labor, not chemistry, is the largest line in most hospitals' disinfection budgets, so the biggest savings come from how time is spent. Products and consumables are the second-largest pool, and they carry the most visible waste.

Cost category	What it includes	Typical source of waste
EVS and nursing labor	Terminal and daily cleans, equipment wipe-downs, isolation rooms	Unstandardized sequences, travel time, re-cleans after failed inspection
Disinfectant chemicals	Ready-to-use sprays, concentrates, sporicides	Overlapping products, over-dilution or under-dilution, unit-level stockpiles

Cost category	What it includes	Typical source of waste
Pre-saturated wipes	Quaternary, alcohol, bleach and peroxide wipes	Several wipe brands per unit, dried-out canisters, wipes used where a cloth would do
Cloths, mops and linen	Cotton rags, string mops, laundering	Short-lived cotton, high water and chemical use, laundry losses
Equipment and technology	UV-C, hydrogen peroxide vapor, carts, dispensers	Underused devices, service contracts with no utilization data
Rework and infection costs	Re-cleans, room-turn delays, HAIs	Missed high-touch surfaces, patient-flow bottlenecks

The last row is the one that turns a cost-cutting project into a safety project. Cleaning thoroughness is often poor at baseline: in a study of 1,404 high-touch objects across 157 rooms in three hospitals, [only 47% had been cleaned](#) before an education and feedback intervention, which then more than doubled cleaning of the worst-performing surfaces. Time spent is not the same as quality: an academic medical center audit found [no correlation between minutes spent cleaning ICU rooms and cleaning adequacy](#).

Failed cleaning is expensive downstream. A JAMA Internal Medicine meta-analysis put the attributable cost of a [C. difficile infection at about \\$11,300 per case](#), and a later U.S. meta-analysis estimated [hospital-onset CDI at about \\$34,000 per case](#) (2015 dollars). A savings program that lets a handful of extra infections through can erase its own gains.

What a generator is

An onsite generator is a device that produces a hypochlorous acid solution at a set concentration, where it is used. It is regulated by the EPA as a device, and the solution it produces carries no efficacy claims of its own.

In a hospital, it removes two failure modes that sit upstream of every cleaning audit:

- **Running out.** Product stock-outs on a unit push staff to substitute whatever is on hand, often a product with a different contact time or no relevant claim.
- **Mis-diluting.** Hand-mixed buckets and drifting dispensers deliver a concentration nobody measured; the chemistry that fails an audit is rarely the chemistry that was specified.

It also removes delivered drums and bottles from the supply chain, and with them storage space, handling, and a share of the chemical training burden. What it does not do is turn the generated solution into a registered disinfectant; where a protocol requires registered claims, the registered product is used (next sections).

The research on hypochlorous acid

This section reports laboratory and published findings on hypochlorous acid against the organisms that drive hospital risk, each stated with its conditions. It makes no claim for any EcoloxTech system.

This edition reports one study in full. Other findings in the EcoloxTech research library have not been reviewed for healthcare surfaces and are not summarized here.

Organism	Laboratory	Method and conditions	Contact time	Result (two replicates)
Murine norovirus MNV-G, the accepted surrogate for human norovirus	Microbac Laboratories Inc., Sterling, Virginia, August 2018	Virucidal hard-surface test on ceramic tile, 5% serum soil load, 21°C; hypochlorous acid at 50 ppm free available chlorine, pH 5 and pH 8	1 minute	pH 5: 4.57 and 5.07 log reduction; pH 8: 4.07 and 3.82 log reduction

The reports were commissioned by IET, Inc. dba EcoloxTech from a named independent laboratory; they are not peer-reviewed and describe one contact time under one set of conditions ([described in full in the Norwegian Cruise Line case study](#)). The two rows differ only in pH, which is why a set point matters as much as a ppm figure.

One finding applies to every row: hypochlorous acid is an oxidizer, and oxidizer consumed by organic soil is not available to act on organisms. Every result above assumes a precleaned surface.

Where documented claims come from

Documented disinfection claims in a hospital come from HOCl-AS200, EPA Reg. No. 101112-1, used according to its label, which specifies a five-minute contact time. They do not come from the generated solution.

The label lists 21 organisms, eight bacteria and thirteen viruses, each at a five-minute contact time on precleaned hard, non-porous surfaces. The bacteria include MRSA, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterococcus faecium*, *Escherichia coli* and *Salmonella enterica*; the viruses include SARS-CoV-2, influenza A, norovirus surrogates (feline calicivirus and murine norovirus), adenovirus type 5 and hepatitis B (duck hepatitis B surrogate). The label also carries an emerging viral pathogen claim. If the product is not used immediately after production, it is tested first and not used below 149 ppm available chlorine. It is not for terminal sterilization of instruments ([product page](#)).

Clostridioides difficile spores are not on the label. A hospital using HOCl-AS200 therefore keeps a separate EPA List K sporicide for C. diff rooms and outbreaks. Extending concentration or contact time beyond the label does not create a spore claim.

The compliance guardrails

None of the major requirements dictates how many products a hospital buys or how its labor is scheduled; they dictate outcomes, claims and documentation. That leaves wide room to cut cost, as long as these guardrails are mapped before any change is made.

Requirement	What it governs	What it means for cost reduction
EPA product label (federal law)	Approved surfaces, dilution and wet contact time	Every consolidated product must be used exactly per label; a cheaper product with a longer contact time can cost more in labor
EPA List K and other EPA lists	Products with verified claims against C. difficile spores and specific pathogens	The rationalized formulary must still include a List K product for C. diff rooms and outbreaks; HOCl-AS200 fills that role only if its label carries the spore claim

Requirement	What it governs	What it means for cost reduction
Spaulding classification (CDC/HICPAC)	Level of processing for critical, semicritical and noncritical items	Surface savings never touch high-level disinfection or sterilization workflows
CDC environmental infection control guidance	Cleaning of high-touch surfaces and monitoring of thoroughness	Supports measured, targeted cleaning rather than more cleaning
CMS Conditions of Participation (§482.42)	A hospital-wide infection prevention and control program	Formulary and workflow changes need sign-off through the infection control program
The Joint Commission, Infection Prevention and Control chapter	Written processes, staff competency, surveillance	Each new product or protocol needs updated policies, training records and audit evidence
OSHA Bloodborne Pathogens and Hazard Communication	Worker protection, safety data sheets, chemical training	Fewer chemicals simplify training and SDS management; automated dilution cuts exposure
Device and equipment manufacturer instructions (IFUs)	Which disinfectants are compatible with each device	The new formulary must be checked against IFUs for monitors, pumps, beds and screens

The practical test for any proposed change: does every surface and device still have a compatible, label-appropriate product with the right pathogen claim, and can the hospital prove the surface was actually cleaned?

The five cost levers

Labor redesign delivers the largest dollar savings; product rationalization delivers the fastest. The ranges below are planning assumptions for the share of each affected cost pool that can be removed, not published benchmarks; validate them against your own baseline.

Lever	What changes	Modeled savings on affected spend	Compliance check before rollout
1. Product rationalization	Cut 15–30 disinfectant SKUs to a short formulary: HOCl-AS200 where registered claims are required, generated hypochlorous acid for routine uses that require none, a List K sporicide for C. diff, which HOCl-AS200's label does not cover, and device-specific products only where an IFU demands them	25–45% of chemical and wipe spend	Every pathogen of concern covered by a label claim; IFU compatibility verified for all devices
2. Onsite generation	A generator produces solution at a set concentration on site, replacing delivered ready-to-use bottles, hand-mixed buckets and their storage	15–30% of remaining chemical spend	Output concentration verified and logged on a set schedule; uses requiring registered claims stay on the registered product
3. Workflow and labor redesign	Standard room-cleaning sequences, task-based (not room-count) staffing, discharge-driven dispatch, less overtime and agency use, clear EVS–nursing split for equipment	15–30% of disinfection labor cost	Precleaning and label contact times built into the standard work; thoroughness audited before and after

Lever	What changes	Modeled savings on affected spend	Compliance check before rollout
4. Targeted technology	Electronic tracking to eliminate missed rooms and re-cleans; adjunct systems such as UV-C limited to isolation and high-risk discharges	Most rework cost, plus labor minutes per turn	Adjuncts used only after manual cleaning; utilization tracked
5. Reusables and reprocessing	Laundered microfiber cloths and flat mops replace cotton and string mops; fewer pre-saturated wipes where a dispensed solution works	40–60% of cloth and mop spend	Microfiber laundering validated; color-coding prevents cross-contamination

Three cautions apply across all five. First, judge each product on cost per correctly disinfected surface, not cost per gallon: a cheap product with a 10-minute contact time can need re-wetting and extra labor. Second, sequence the levers so that measurement (lever 4's tracking and the audit program in the compliance section) is in place before staffing changes, not after. Third, generated solution and registered product are not interchangeable on paper: the formulary and the room cards must say which one each task uses.

Illustrative savings model: a 300-bed hospital

In this model, annual disinfection spend falls from \$4.00M to \$2.40M, a 40% reduction, with workflow and labor redesign the largest single step. The baseline below is a composite assumption, not data from a real hospital.

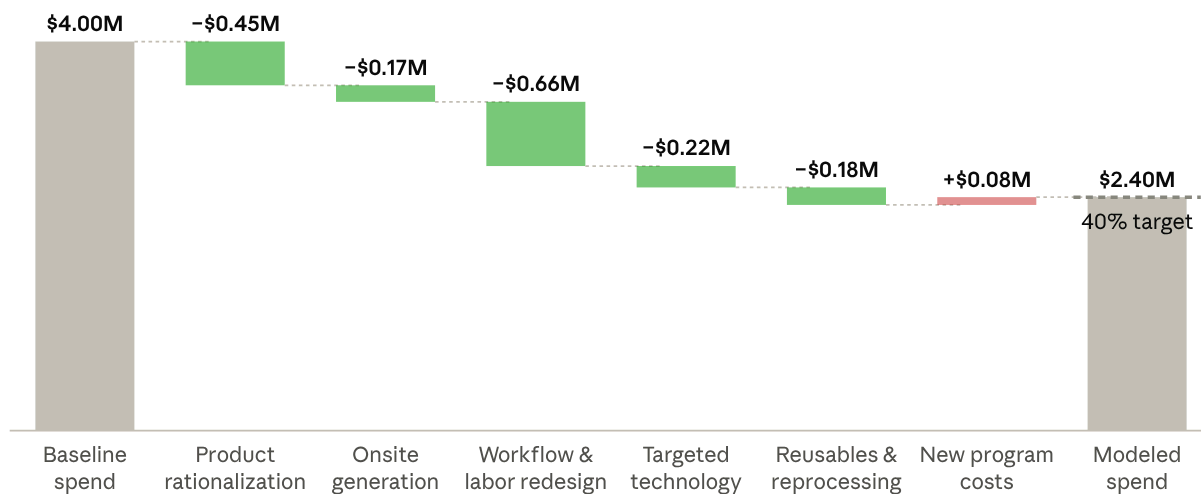
Baseline cost pool	Annual spend	Share
EVS and nursing labor for disinfection	\$2.20M	55%
Pre-saturated wipes	\$0.65M	16%
Disinfectant chemicals	\$0.45M	11%

Baseline cost pool	Annual spend	Share
Cloths, mops and linen	\$0.30M	8%
Equipment and service contracts	\$0.25M	6%
Rework and re-cleans	\$0.15M	4%

Labor redesign is the largest step in a 40% cost reduction

Annual disinfection spend, illustrative 300-bed hospital: \$4.00M to \$2.40M (–40%)

Green = savings · Red = new program costs (audits, training, dispensers) · Grey = total spend



Illustrative model built for this paper · annual figures, US dollars · not data from a specific hospital

The model sits near the top of each lever's range, so a full 40% assumes a high-waste starting point: many SKUs, ready-to-use products, cotton cloths and room-count staffing. A hospital that already uses concentrates and microfiber should plan for roughly 20–30%.

This composite is illustrative. It is not EcoloxTech deployment data or a hospital's accounts; the cost analysis that follows uses EcoloxTech prices and a published hospital estimate instead.

Cost analysis: onsite generation against a 250-bed hospital

For a 250-bed hospital, onsite generation cuts the cost of daily room cleaning only on the volume that does not need an EPA-registered claim. At half the volume the saving is about \$27,000 a year against a ready-to-use spray program, and it disappears as the registered share nears 95%. The hospital figures are a published per-room estimate for a 250-bed hospital, not a named hospital's invoices.

Inputs

Input	Figure	Source
EcoloxTech 300 generator	\$9,999 list, 300 L/hr; amortized over 5 years = \$2,000 a year	EcoloxTech generators page
Production cost of generated HOCl	\$0.03 per litre assumed (range \$0.01–\$0.05)	EcoloxTech states "low cents per litre"; \$0.03 used as a midpoint assumption, confirmed per site in the sanitation audit
Concentration checks	High-range strips at \$39.99 per 50; one check per shift, three shifts a day = about \$876 a year	EcoloxTech shop
HOCl-AS200	\$5.95 per US gallon (\$1.57 per litre) in 275-gallon totes (\$1,636.25 per tote), hospital-group contract price; retail list is \$39.99 per gallon	HOCl-AS200 product page
Hospital RTU disinfectant spray	30 one-ounce sprays per room per day at \$0.022 per ounce = \$0.67 per room	Birchfield, Healthcare Facilities Today, 2014
Hospital RTU bleach-derivative wipes	7 wipes per room per day at \$0.28 = \$2.00 per room	Same source; it prints ".28 cents" per wipe, but its \$2.00 per room implies \$0.28
Daily-clean volume	250 rooms × 30 oz × 365 days = about 81,000 litres a year	Derived from the two rows above

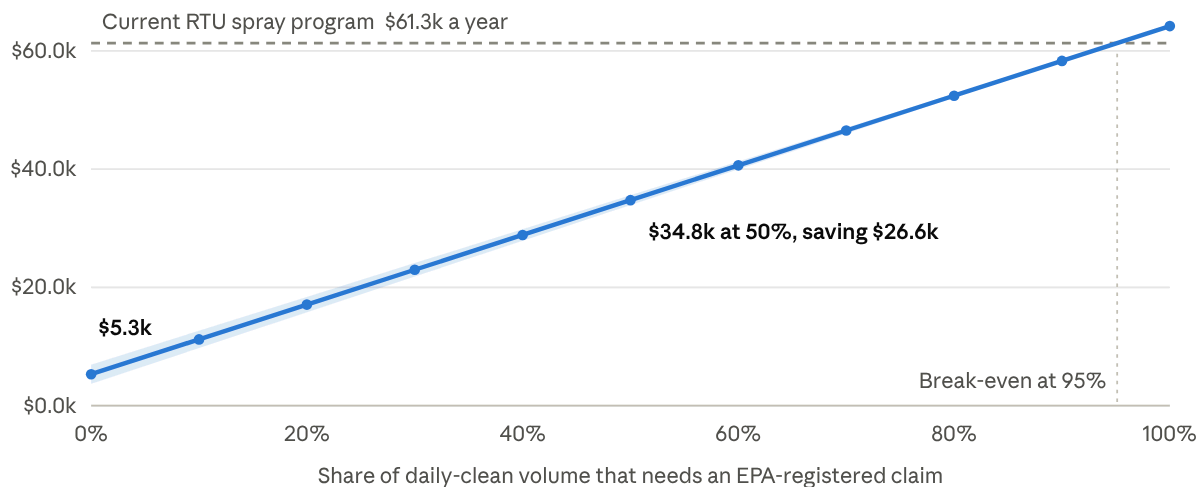
Annual cost of daily room cleaning

Program	Annual cost	Carries registered claims for patient rooms?
RTU bleach-derivative wipes	\$182,500	Yes

Program	Annual cost	Carries registered claims for patient rooms?
RTU disinfectant spray	\$61,320	Yes
HOCI-AS200 at the \$5.95 contract price, all volume	about \$127,000	Yes, except <i>C. difficile</i> spores
Generated HOCl, all volume	about \$5,300	No: not usable where a registered disinfectant is required

Savings shrink as more of the volume needs a registered claim

Annual cost of daily room cleaning, 250-bed hospital: generated HOCl for non-claim volume, current RTU spray for the rest
Shaded band = production cost of \$0.01–\$0.05 per litre; line = \$0.03 assumed



Computed from the inputs table above · hospital prices from a 2014 published estimate, not inflation-adjusted · production cost of \$0.03 per litre assumed

A real program sits somewhere on this line: generated solution for work that needs no claim, the hospital's registered product for the rest. Where that split falls is set by the hospital's infection prevention policy, and it is the first number to establish in an audit.

Contract pricing: E-300 plus HOCl-AS200 for a hospital group

Under a group contract at \$5.95 a gallon in 275-gallon totes, each 250-bed hospital in the group saves against its RTU spray as long as less than about 45% of its daily-clean volume needs the registered product. For a five-hospital group with a quarter of its volume on AS200, that is about eight totes a month and about \$124,000 a year in group savings. Each hospital runs its own E-300 for the work that needs no claim.

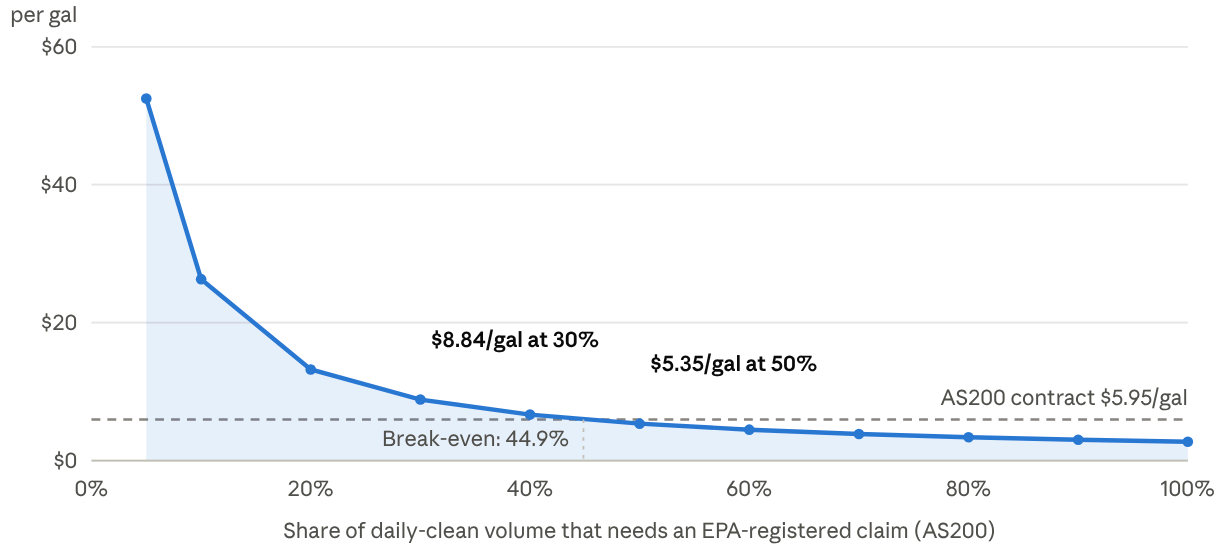
Term	Proposed
Product	HOCl-AS200, EPA Reg. No. 101112-1
Pack	275-gallon tote
Contract price	\$5.95 per gallon (\$1,636.25 per tote)
Buyer	Hospital group of five 250-bed hospitals (assumed)
Equipment	One EcoloxTech 300 per hospital, \$9,999 list each
Volume basis	25% of daily-clean volume on AS200: about 26,700 gallons, or 97 totes, a year (about 8 totes a month across the group)
Annual AS200 contract value	About \$159,000
Set per contract	Minimum monthly commitment, contract term, delivery and freight, price adjustment, and shelf life of an opened tote

Registered share of volume	Group AS200 a year	Totes a month	Group annual cost	Versus group RTU spray (\$306,600)
10%	10,694 gal	3.2	\$88,940	\$217,660 less
20%	21,387 gal	6.5	\$151,351	\$155,249 less
25%	26,734 gal	8.1	\$182,557	\$124,043 less
30%	32,081 gal	9.7	\$213,763	\$92,837 less
40%	42,774 gal	13.0	\$276,174	\$30,426 less
50%	53,468 gal	16.2	\$338,586	\$31,986 more

At the \$5.95 contract price, the combination pays below a 45% registered share

AS200 price per gallon at which E-300 + AS200 costs the same as the current RTU spray, 250-bed hospital

Shaded area = AS200 prices at which the combined program saves money



Computed from the inputs table above · E-300 output at \$0.03 per litre assumed · RTU spray program \$61,320 a year

The deciding number is AS200's contract price, not the generator. Against bleach-derivative wipes (\$182,500 a year per hospital, \$912,500 for the group) the combination costs less at every split, up to and including 100% AS200. Group costs include one E-300 per hospital at \$2,876 a year in fixed costs; they assume exact gallons, so whole-tote ordering and freight are not included. If AS200 could be produced on site by the E-300 under its registration — still to be confirmed with the registration holder — registered volume would cost the same as generated volume, and each hospital's program would cost about \$5,300 a year whatever the split.

What the numbers leave out

- **HOCl-AS200 pricing.** At the \$5.95 contract price, AS200 on its own costs less than bleach-derivative wipes but still about 2.1 times the incumbent spray per gallon (\$2.82); against spray it pays when combined with generated solution for the work that needs no claim. Bulk supply also raises two practical questions: how long a tote stays above the label's 149 ppm minimum once opened, and how the hospital decants and distributes from a 275-gallon container.
- **EcoloxTech-side costs not yet priced:** installation, water softening, holding tank, annual service and spare parts, all quoted per site. Each one lowers the saving.

- **Hospital-side costs not counted:** freight, storage, handling and container disposal for delivered product, which the Norwegian Cruise Line case study also left out. Each one raises the saving.
- **Scope.** The hospital figures are 2014 prices and cover daily room cleaning only: no terminal cleans, isolation rooms, equipment wipe-downs or sporicide. No labor difference is assumed in either direction.

Proving compliance while costs fall

The program stays compliant only if cleaning quality is measured objectively before, during and after every change, and if a drop in quality stops the rollout. Visual inspection alone is not enough evidence for a surveyor or for infection prevention.

- **Fluorescent marker audits.** Mark a fixed set of high-touch surfaces before terminal cleaning and check removal afterward. This measures thoroughness and gives staff immediate feedback; in the study cited earlier, feedback alone more than doubled cleaning of poorly cleaned surfaces.
- **ATP bioluminescence.** Measures residual organic material and complements markers, which show a surface was wiped but not how clean it is. Comparative studies show the two methods can disagree, so use both rather than either alone ([ICHE comparison](#)).
- **Contact-time adherence.** Observe a sample of cleans each month to confirm surfaces stay visibly wet for the label's full contact time.
- **Dilution verification.** Test-strip or titrate dispensed solutions on a set schedule and log the results.
- **Outcome surveillance.** Track hospital-onset *C. difficile*, MRSA and VRE rates monthly by unit, alongside room-turn times and patient-experience cleanliness scores.

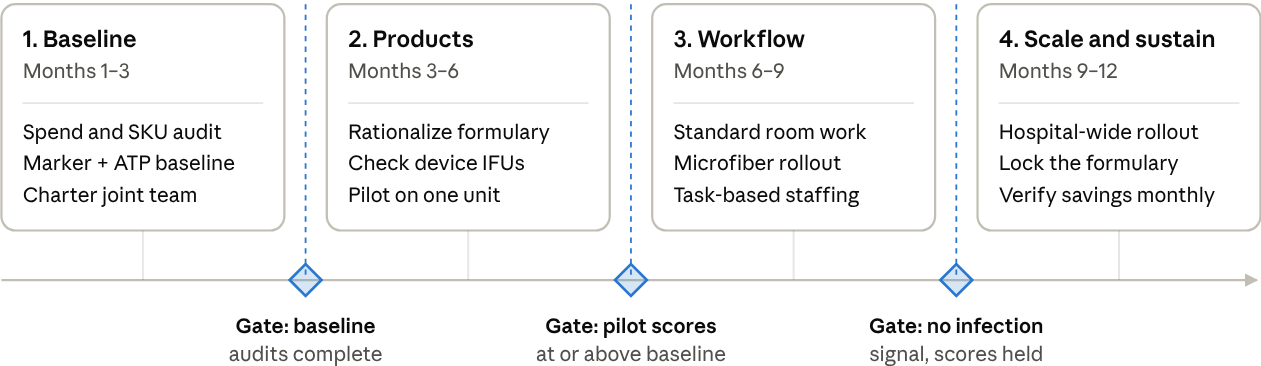
Set the guardrails before launch. A workable rule: if the thoroughness score on any unit falls more than 5 points below baseline for two consecutive months, or a hospital-onset infection signal appears, the change on that unit pauses until infection prevention clears it. Keep every audit result, training record and policy revision in one binder or system so a Joint Commission or CMS surveyor can trace any product or protocol change from approval to validation.

Implementation roadmap

Roll out over 12 months in four phases, and move to the next phase only after infection prevention signs off on the audit data. Product changes come before labor changes, because they are lower-risk and fund the measurement program.

Each phase must pass a compliance gate before the next begins

12-month rollout; diamonds are infection prevention sign-off points



Implementation roadmap · 4 phases, 3 compliance gates

Governance is simple: an executive sponsor, a monthly steering meeting of EVS, infection prevention, supply chain, nursing and finance, and one shared dashboard showing spend, thoroughness scores and hospital-onset infection rates side by side. Infection prevention holds a veto at every gate.

Risks and pitfalls

Most failed disinfection savings programs fail the same few ways, and each has a known countermeasure.

Pitfall	What goes wrong	Countermeasure
Cutting labor before measuring	Staffing drops, thoroughness falls unnoticed, infections rise	Run baseline audits for 2-3 months before any staffing change
Buying on price per gallon	A cheaper product needs longer contact time or re-wetting, adding labor	Compare cost per compliant clean, including labor minutes

Pitfall	What goes wrong	Countermeasure
Device damage	A consolidated chemistry degrades screens, plastics or seals on equipment	Check every high-value device IFU before switching; pilot on one unit
Losing the sporicide	Rationalization drops the only List K product	Keep a dedicated sporicide in the formulary, with a clear trigger for its use
Technology as a substitute	UV-C or vapor systems replace manual cleaning of soiled surfaces	Written policy: technology is used only after manual cleaning
Staff resistance and turnover	Frontline EVS staff see the program as speed-up, and quality drops	Share audit results, involve staff in redesign, reinvest part of savings in pay or training
Savings that do not stick	Units reorder old favorite products outside the formulary	Lock the formulary in the purchasing system; review off-contract spend monthly

What onsite generation does not fix

A generator removes stock-outs and mis-dilution. It leaves the rest of the problem where it was.

- **Precleaning.** Organic soil consumes oxidizer. A program that disinfects dirty surfaces underperforms regardless of the chemistry or the label.
- **Spores.** HOCl-AS200's label does not include *C. difficile* spores, so *C. diff* rooms still need a List K sporicide.
- **Labor discipline.** Most of the savings in the model come from workflow, not chemistry; a generator does not make a room sequence standard.
- **Equipment and supply.** The generator needs feed water that meets its specification, routine maintenance and a spare-parts plan; downtime returns a unit to delivered product.
- **Device compatibility.** Some device IFUs name specific disinfectants, and those devices stay on them.
- **Infection outcomes.** Nothing in this paper shows that onsite generation reduces healthcare-associated infections, and we make no such claim.

Questions to ask any supplier

Ask these of us, and of anyone else proposing a change to your disinfection program:

1. Which product carries the registered claims for each task, and what is its EPA registration number?
2. Does that label include *C. difficile* spores, and is the product on EPA List K?
3. What contact time does the label require, and does your workflow keep surfaces wet that long?
4. Which of our devices' IFUs permit this chemistry, and which do not?
5. How is output concentration verified, how often, and where is it logged?
6. What happens on a unit when the generator is down?
7. Which cost figures are your own data, and which are modelled?
8. Which research applies to our surfaces and conditions, and can we read the reports themselves?

Conclusion and next steps

A 40% reduction in disinfection cost is achievable for many hospitals because most of the spend is waste, not protection. The hospitals that succeed treat it as a quality project with a cost outcome: they measure first, consolidate products against a claims-and-compatibility map, redesign work around contact times, and give infection prevention the power to stop any change that slips.

Three steps start the work this quarter:

1. Pull 12 months of disinfection-related spend by category, including labor hours, and count active disinfectant SKUs.
2. Run a baseline of fluorescent marker and ATP audits on at least three units.
3. Charter a joint EVS, infection prevention, supply chain and nursing team with a named executive sponsor.

If it would help to see this analysis applied to your own hospital before you start, the EcoloxTech sanitation audit produces it in writing — your volumes, your current spend and a sized recommendation — at no cost.

Hospital groups can request contract pricing on HOCl-AS200 in 275-gallon totes, alongside an E-300 at each site; the contract terms and the savings at each split are in the cost analysis.

Sources and methodology

The savings model and lever ranges in this paper are illustrative planning assumptions for a composite 300-bed hospital, not results from a specific institution. Replace them with your own baseline before using them in a business case. This paper is not legal or regulatory advice; confirm requirements with your infection prevention, compliance and accreditation teams.

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- U.S. EPA. [List K: products effective against C. difficile spores](#).
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- EcoloxTech. [HOCl-AS200 product page and label summary](#).
- EcoloxTech. [Hypochlorous acid generators: specifications and pricing](#).
- EcoloxTech. [Shop: consumables and test strips](#).