Scientific–Economic Report

Subject: Workforce Absenteeism, Seasonal Respiratory Infections and Continuous Air Disinfection

A Scientific–Economic Assessment of STERYBOX as a Complementary Infection-Control Technology in Healthcare Environments to reduce Staff Sick Leave and Operational Costs in Healthcare Facilities

Prepared with reference to international scientific literature on respiratory infection transmission, workforce absenteeism, indoor air quality, UV-C/UVGI air disinfection, and the documented microbiological performance of STERYBOX air disinfection systems.

Reference Documents:

- *Scientific Report Summary on STERYBOX 2025, TISSIMedica / TISSI S.R.L.*
- *CDC/HICPAC Guidelines for Environmental Infection Control in Health-Care Facilities*
- *Published international studies on influenza-related absenteeism, ventilation, UVGI, face masks and occupational productivity loss.*

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1. Executive Summary

Airborne respiratory infections represent a major clinical and economic burden for hospitals, dental clinics, laboratories and high-density healthcare environments. While hospital infection-control strategies traditionally focus on severe airborne nosocomial infections, the same environmental transmission pathways are also involved in common seasonal respiratory diseases such as influenza, influenza-like illness, common cold viruses and other viral respiratory tract infections.

These “ordinary” seasonal infections can produce significant operational consequences: staff absenteeism, presenteeism, overtime costs, replacement staffing, reduced productivity, postponed procedures and lower continuity of care. The problem is not limited to one region. Published data from Europe, the United States, Australia, Japan and Hong Kong confirm that

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influenza and influenza-like illnesses generate measurable productivity losses and increased sickness absence among working adults and healthcare personnel.

STERYBOX, based on enclosed UV-C germicidal irradiation at 254 nm and the patented UV-CHRIS high-reflecting coil system, continuously recirculates and disinfects indoor air while rooms remain occupied. Its scientific documentation reports up to 99.99% reduction of airborne contamination within 30 minutes, complete inactivation of selected tested microorganisms under laboratory conditions, and more than 95% airborne bacterial reduction in hospital environments.

STERYBOX should therefore be positioned not only as a complementary technology for reducing dangerous airborne nosocomial infections, but also as an environmental infection-control measure that may contribute to reducing the circulation of common seasonal respiratory pathogens, with potential benefits in terms of lower staff sick leave and improved workforce continuity.

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2. International Burden of Seasonal Respiratory Infections on Workforce Productivity

2.1 Europe and United Kingdom

Seasonal influenza and influenza-like illness create substantial productivity losses in Europe. A systematic review reported that laboratory-confirmed influenza is associated with a mean loss of approximately 1.5 to 4.9 working days per case. (PubMed)

In the United Kingdom, RAND Europe estimated that approximately 2.4 million working adults may fall ill with influenza annually, corresponding to around 4.8 million working days lost due to absence from work or reduced productivity while working. RAND also noted that influenza seasons generate increased pressure on the NHS, including excess emergency admissions and longer waiting times. (rand.org)

A 2024 UK employer-cost report on respiratory infections estimated that employees are affected by respiratory infections for an average of 5.2 working days per year, including 1.1 days of absence and 4.1 days of presenteeism, with productivity during presenteeism reduced by approximately 32%. The same report estimated the employer productivity cost at £852 per employee per year and a national UK economic cost of £44 billion. (ohe.org)

These figures demonstrate that even non-severe respiratory infections have a significant economic impact when multiplied across large healthcare workforces.

2.2 United States

In the United States, influenza-related workplace productivity loss has been studied in employed adults with acute respiratory illness. Van Wormer et al. found that laboratory-

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confirmed influenza was significantly associated with productivity loss, and that participants with influenza had greater mean productivity loss than those with non-influenza acute respiratory infections. (stacks.cdc.gov)

A review of influenza and influenza-like illness productivity burden reported that the average per-patient cost associated with influenza-related workplace absence was approximately USD 209.66, with higher costs in certain vaccine-mismatched seasons. (PMC)

The US data are particularly relevant for healthcare and clinical environments, where each absence may require replacement staff, overtime, rescheduling or reduced service capacity.

2.3 Australia

Australian workplace literature also recognizes infectious illness as a relevant productivity and cost issue. A study on workplace infectious illness management in Australia stated that infectious illnesses create substantial cost and productivity impacts for organizations. (ScienceDirect)

Although Australian influenza-specific employer-cost data are less consistently reported in open-access scientific sources than in Europe or the United States, general Australian productivity-loss studies confirm that absenteeism can generate substantial annual costs at workforce level. In one Australian workforce study, estimated absenteeism-related productivity loss was approximately AUD 1.26 million per 1,000 employees per year, although this figure refers to broader health-related absence rather than influenza alone. (PMC)

For healthcare operators, this supports the broader economic principle: reducing preventable respiratory transmission may help reduce avoidable absence costs and operational disruption.

2.4 Japan

Japan has a strong occupational-health interest in productivity loss, absenteeism and presenteeism. Data cited in an Italian influenza absenteeism review refer to a Japanese healthcare-worker study at Gifu Red Cross Hospital during the 2002–2003 influenza season, where influenza-related sick leave averaged approximately 2.8 days per episode among reported cases. (pdfs.semanticscholar.org)

Japan is also a relevant reference market because mask use during respiratory illness and high public sensitivity to seasonal respiratory transmission have long been culturally and operationally important. While mask use and air disinfection are different interventions, both target the same practical objective: reducing exposure to infectious respiratory particles in shared indoor spaces.

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2.5 Hong Kong and Regional Healthcare Context

Hong Kong provides particularly relevant healthcare data because of its dense hospital environments and history of strong respiratory infection-control practices.

A Hong Kong study of healthcare workers found that influenza epidemics were associated with a substantial increase in sickness absence and productivity loss. The increase in overall absenteeism was highest among medical staff, reaching 51.3% during seasonal influenza epidemic periods and 142.1% during the 2009 pandemic mitigation period. (HERO)

Another Hong Kong study on nurses in acute-care hospitals reported that 71.3% of nurses had two or more presenteeism events in the previous year and investigated how seasonal influenza-related hospital occupancy affected sickness presenteeism and productivity costs. (MDPI)

Hong Kong should therefore be considered a strong regional example, but not an isolated case: the same economic and workforce logic applies to Europe, North America, Australia and Japan.

3. Scientific Evidence Linking Indoor Air Treatment to Reduced Illness and Absenteeism

Respiratory pathogens spread through droplets, aerosols and contaminated indoor air. Therefore, interventions that reduce airborne pathogen concentration may help reduce transmission risk when used together with standard infection-control measures.

3.1 Ventilation and Sick Leave

A landmark office-worker study found that lower outdoor air supply rates were associated with higher short-term sick leave. The relative risk of short-term sick leave was 1.53 in areas with lower ventilation, and the attributable risk among workers exposed to lower outdoor air supply was estimated at 35%. (PubMed)

This supports the principle that indoor air quality and air renewal are not only comfort factors, but also measurable determinants of workforce health and absence.

3.2 Upper-Room UVGI and Respiratory Absenteeism

Evidence from germicidal ultraviolet systems also supports the infection-control value of air disinfection. A 2023 analysis of preschool data found that upper-room germicidal UV was associated with reduced respiratory-related absenteeism. Model-predicted absenteeism rates

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were reduced by between one-third and one-half outside high summer periods. (IDEAS/RePEc)

Although this study was not performed with STERYBOX and involved school settings rather than hospitals, it is directly relevant to the scientific principle that continuous UV air disinfection can reduce respiratory illness-related absenteeism.

3.3 Face Masks and Respiratory Source Control

Mask studies provide additional support for reducing exposure to respiratory particles. A systematic review on face masks and influenza transmission found that adherent use of masks may reduce influenza-like illness transmission in certain settings, particularly when combined with other measures. (Cambridge University Press & Assessment)

Another review reported that mask-wearing combined with enhanced hand hygiene reduced transmission of influenza-like illness and laboratory-confirmed respiratory infection. (PMC)

The relevance for STERYBOX is conceptual and practical: masks reduce emission and inhalation at the individual level, while continuous air disinfection reduces microbial burden at the environmental level. These interventions are complementary, not mutually exclusive.

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4. STERYBOX Technical Rationale

STERYBOX is designed to reduce airborne microbial contamination through continuous enclosed UV-C disinfection.

Key characteristics relevant to respiratory infection-control include:

1. **UV-C germicidal irradiation at 254 nm**
   STERYBOX uses UV-C irradiation to damage microbial genetic material and inactivate microorganisms.

2. **Patented UV-CHRIS high-reflecting coil system**
   The device draws ambient air through silent fans and passes it through a mirrored stainless-steel coil/labyrinth designed to reflect and amplify UV-C exposure, improving irradiation contact with recirculated air.

3. **Continuous operation in occupied rooms**
   UV-C radiation is confined inside the device, allowing continuous use in the presence of patients, staff and visitors.

4. **No ozone generation under reported test conditions**
   The STERYBOX scientific report includes TEI.SI testing with ozone measurements below 100 µg/m^3 at the air outlet and at 5 metres.

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5. **No filter-based microbial accumulation**
   STERYBOX does not rely on HEPA or other filters for microbial capture. Its mechanism is direct UV-C inactivation inside the unit.

6. **Documented airborne microbial reduction**
   The scientific report documents 80% reduction after 10 minutes, 95% after 20 minutes and up to 99.99% after 30 minutes in controlled airborne contamination tests.

7. **Clinical-environment validation**
   Hospital testing reported airborne bacterial reductions above 95% in real clinical departments.

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5. Relationship with Nosocomial and Seasonal Respiratory Infection Prevention

STERYBOX should be described as a **complementary environmental infection-control technology**. It does not replace:

- vaccination,
- hand hygiene,
- surface disinfection,
- PPE,
- masks when clinically indicated,
- ventilation,
- isolation procedures,
- HVAC engineering controls,
- standard hospital infection-control protocols.

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However, STERYBOX may strengthen these strategies by continuously lowering the airborne microbial burden in occupied indoor spaces.

This is important because hospitals and dental clinics are exposed to two overlapping risks:

1. **High-severity airborne nosocomial infections**
   These include infections associated with airborne transmission, immunocompromised patients, operating areas, emergency rooms and high-risk clinical departments.

2. **High-frequency seasonal respiratory infections**
   These include influenza, influenza-like illness, common cold viruses and other respiratory infections that may not always be severe but can produce repeated staff absences and productivity losses.

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By acting on the shared airborne transmission pathway, STERYBOX may support both clinical safety and operational continuity.

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6. Estimated Annual Workforce Savings Model

The following model is illustrative and should not be presented as a guaranteed economic outcome. It is based on published respiratory-infection productivity data and assumes that STERYBOX is part of a broader infection-control strategy.

The UK employer-cost report estimated respiratory infections at approximately £852 per employee per year in productivity loss, including absenteeism and presenteeism. (ohe.org)

Using this figure as an international reference model:

Workforce Size	Estimated Annual Respiratory Infection Productivity Cost	Potential Saving at 10% Reduction	Potential Saving at 20% Reduction	Potential Saving at 30% Reduction
100 employees	£85,200/year	£8,520	£17,040	£25,560
500 employees	£426,000/year	£42,600	£85,200	£127,800
1,000 employees	£852,000/year	£85,200	£170,400	£255,600

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For European users, the same model may be approximately converted into euros depending on exchange rate and salary structure. In hospitals, the real operational value may be higher than the simple productivity calculation because absences can generate overtime, temporary staffing, cancelled appointments, delayed procedures or reduced clinical capacity.

A more conservative model based only on absence days may also be used. If each employee loses 1.1 working days per year due to respiratory infections, as reported in the UK employer-cost study, then:

Workforce Size	Estimated Absence Days per Year	Avoided Days at 10% Reduction	Avoided Days at 20% Reduction	Avoided Days at 30% Reduction
100 employees	110 days	11 days	22 days	33 days

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Workforce Size	Estimated Absence Days per Year	Avoided Days at 10% Reduction	Avoided Days at 20% Reduction	Avoided Days at 30% Reduction
500 employees	550 days	55 days	110 days	165 days
1,000 employees	1,100 days	110 days	220 days	330 days

This model does not include presenteeism, overtime, staff replacement, lost clinical revenue or the indirect cost of disease transmission from symptomatic staff to colleagues, patients or visitors.

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7. Practical Positioning for Hospitals, Clinics and Dental Facilities

STERYBOX may be presented as an environmental support technology for:

- hospital wards,
- emergency departments,
- outpatient clinics,
- dental clinics,
- laboratories,
- waiting rooms,
- staff rooms,
- long-term care facilities,
- operating support areas,
- high-density administrative healthcare offices.

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The most credible positioning is:

STERYBOX is a complementary continuous UV-C air disinfection system designed to reduce airborne microbial contamination in occupied healthcare environments. By lowering airborne microbial burden, it may support hospital infection-control programs not only against high-risk nosocomial pathogens, but also against common seasonal respiratory infections that generate staff absenteeism, presenteeism and operational costs.

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8. Scientific and Commercially Safe Conclusion

The available international literature confirms that seasonal respiratory infections generate significant productivity losses in Europe, the United States, Australia, Japan and Hong Kong. Evidence from ventilation studies, UVGI applications and respiratory source-control measures supports the general principle that reducing airborne infectious exposure can reduce respiratory illness transmission and related absenteeism.

STERYBOX applies this principle through continuous, enclosed UV-C air disinfection. Its documented airborne microbial reduction, safe operation in occupied rooms, absence of ozone generation under reported test conditions and clinical-environment validation make it a credible complementary technology for healthcare facilities seeking to reduce both severe airborne nosocomial infection risks and the everyday burden of seasonal respiratory disease transmission.

The expected benefit is dual:

1. **Clinical benefit**
   Support for airborne infection-control strategies and reduction of airborne microbial contamination.

2. **Economic and operational benefit**
   Potential reduction of staff illness, sick leave, presenteeism, replacement costs and seasonal workforce disruption.

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Methodological Note

The economic estimates in this report are illustrative models derived from published absenteeism and productivity studies. They are not intended as guaranteed savings or as direct clinical outcome claims for STERYBOX. Actual results depend on room size, air recirculation rate, installation layout, pathogen type, baseline ventilation, occupancy density, staff behavior, vaccination rates, mask policies, cleaning procedures and overall infection-control compliance.

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