

## Research Article

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## Stethoscope Hygiene, Workflow, and Patient Safety: The Crux of Healthcare Associated Infections

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**Abstract**

**Background:** Alcohol based hand cleaners are installed throughout almost every health care facility in support of hand hygiene. However, despite numerous attempts, no study has ever demonstrated this strategy is effective for the stethoscope, which carries the same pathogens. Recently, a touch free disposable barrier stethoscope diaphragm system became available (The Disk Cover; Aseptiscope, Inc, San Diego, CA). Our objective was to perform a pilot feasibility trial to evaluate the impressions and perceived workflow consequences of its installation in the clinical environment.

**Patients and Methods:** Beginning in 2020, we performed a volunteer survey given to aseptic stethoscope diaphragm barrier users in multiple US healthcare facilities. A 10-question survey was presented on an iPad near the aseptic barrier dispenser, which was usually located in the patient's exam room, to be available immediately after the practitioner completed their examination, which included the use of the stethoscope barrier. This evaluation was considered as a quality improvement project and was exempt from IRB approval. For this analysis, only one survey per practitioner was included. Data presented as means (standard deviation).

**Results:** Overall 147 surveys obtained from seven institutions geographically distributed across the US, shortly after placement of the Disk Cover system in the patient care environment. Responses were generally positive, and included ease of use (93.5% rated easy or very easy), comparison to a disposable stethoscope (100% as similar to, improved over, or significant improvement), work-flow changes (63.9% improvement, 97.6% no impact or improved) and perceived effect on patient safety (93.5% felt patient safety was improved or significantly improved).

**Conclusions:** The use of a touch-free aseptic stethoscope barrier system was reported as easy to use, superior to a disposable stethoscope, and was an improvement to practitioner workflow and perceived patient safety.

**Keywords:** Stethoscope, Infection Prevention, Healthcare Associated Infection

## Introduction

Over 150 years ago, Ignaz Semmeleweis created havoc in the medical profession with the radical concept that physicians should wash their hands between patients [1,2]. Disrespected, denigrated, and ridiculed, he would later die in an insane asylum [3]. Today, almost no medical practitioner would consider touching a patient without first performing hand hygiene, and most patient surveys have incorporated questions on provider's hand hygiene adherence. It is ironic that the stethoscope has escaped similar inspection. Although the stethoscope diaphragm carries the identical microbes as cultured from hands, the unwashed stethoscope is allowed to spread the exact same microbes that hand hygiene removes [4-7]. In fact, current CDC (Center for Disease Control and Prevention) guidelines suggest weekly stethoscope cleaning is adequate, unless the stethoscope is "visibly soiled" [8]. "Visibly soiled" is an unacceptable hygiene threshold. A physician who engaged in "washing their hands weekly, unless visibly soiled", would be unacceptable. While it is likely that healthcare workers not practicing hand hygiene would face disciplinary action, the stethoscope continues to spread the exact same microbes that were just washed off the hands.

Some have promoted that a hand hygiene strategy should be applied to the stethoscope. Medical practitioners are guided to wash their stethoscope with an alcohol swab for 60 seconds before every patient contact. Unfortunately, this is a misguided strategy. Despite being tested in thousands of patient encounters, we could not find a single publication where a "clean your stethoscope" strategy was documented to be effective [7,9-13]. And unfortunately, even in the unlikely event that every practitioner cleaned their stethoscope prior to every patient encounter, studies where cultures were done before and after stethoscope cleaning have found this strategy to also be ineffective, as nearly 1/3 of cleaned stethoscopes continue to harbor persistent pathogens [14-20].

This ultimately begs the question of "can the stethoscope serve as a vector?" Multiple modeling studies have demonstrated that bacteria on one patient can be transferred to another patient in a completely different room, simply by the unclean stethoscope [21-24]. Additionally, in clinical practice, multi-drug resistant pathogens have been documented to also be shared via the stethoscope [25]. Therefore, the lack of an effective cleanliness standard for the stethoscope microbe transportation system represents a significant gap in the fight against healthcare associated infections.

Although the stethoscope diaphragm is considered the second most contaminated area, after the fingertips, obstacles to its hygiene are twofold:

- 1) Impedance of a practitioner's work flow when they are required to clean the stethoscope diaphragm before each patient, and
- 2) Limited effectiveness of stethoscope hygiene, even when the stethoscope is cleaned based on current recommendations.

A busy healthcare provider, seeing 50 patients a day, needs to

spend almost two hours a day cleaning their stethoscope (60 seconds with an alcohol swab before and after each patient), simply to lower, but never eliminate, the concentration of pathogens on their stethoscope.

Recently, publications on the use of a hands-free stethoscope barrier system (Figure) suggests that an aseptic stethoscope-patient contact can be obtained. While the barrier efficacy and an absence of acoustic impact on the stethoscope's function have been well documented, questions regarding the workflow implications of using a stethoscope barrier remain [26-28]. As stethoscope barriers are not a routine part of contemporary medical practice, our purpose was to perform a pilot feasibility study using a survey of aseptic stethoscope diaphragm barrier users to determine the impact on their impressions resulting from the implementation of a touch-free stethoscope barrier system into their clinical practice.



**Figure:** Hands Free Stethoscope Aseptic Barrier Dispenser

## Methods

Beginning in January 2020, until March of 2021, with each hospital collecting data for a 2-week period, we performed a workflow perception evaluation after the installation of aseptic stethoscope barrier dispenser systems. This consisted of a volunteer survey obtained from the pre-specified users of aseptic stethoscope diaphragm barriers (Aseptiscope, Inc, San Diego, California) in multiple patient settings at seven healthcare care facilities across the US (Table 1). The 10-question survey (Table 2) was presented on an iPad mounted on a pole, near the barrier dispenser, which was most commonly located inside of the patient's exam room, to be immediately available after the practitioner completed their examination. This strategy was used because dispensers are located in different areas throughout a hospital and our objective was to obtain the survey data immediately after barrier use. Data was collected in a blinded fashion (no personal identifiers were documented) to reduce the potential of reporter bias resulting from the possibility of administrative supervision that could alter the completion of the survey. Survey responses were collected via a comparative ordinal scale for "ease of use," "comparison to a dis-

posable stethoscope,” “workflow impact,” “stethoscope hygiene impact,” and “patient safety impact.” Responses were collected by a nominal ordinal scale for “personal stethoscope cleaning frequency,” determining “what distance from the patient would represent optimal dispenser location,” and as to “the potential for future applications.” The participating institutions defined this evaluation

as a quality improvement project and thus exempt from institutional review board approval. For this analysis, repeated survey responses were excluded. Data is presented as means (standard deviation), rates, and as composite rates for specific clinically relevant responses. Aseptiscope, Inc (San Diego, CA) supported this study.

**Table 1: Participating Institutions and Department**

Institutional Name	Location	Department
City of Hope, Cancer Center	Duarte, CA	Intensive Care Unit
University of California, San Diego	San Diego, CA	Urgent Care Center
University of California, San Diego	San Diego, CA	Internal Medicine Clinic
Dayton Physicians	Dayton, OH	Oncology Clinic
BronxDocs	Bronx, NY	Internal Medicine Clinic
Wahiawa General Hospital	Wahiawa, HI	General Medical Floor
Select Specialty	Denton, TX	Internal Medicine Clinic

## Results

Overall, there were 147 survey respondents from seven different institutions. Participants consisted of 68 (46.3%) nurses, 38 (25.8%) physicians, 25 (17%) “Other”, 13 (8.8%) nurse practitioners and 3 (2.0%) physician assistants. See table 2. This distribution of practitioners is reflective of the distribution of clinical stethoscope users entering patient’s hospital rooms in the United States. In regards to the ease of use of the touch free barrier dispenser, participants answered with a range of “very hard” to “very easy,” and provided a mean (standard deviation: sd) answer of 4.6 (0.6) on a 1 to 5

comparative scale. Of these, 93.5% rated the barrier as “very easy” (60.7%) or “easy” (32.8%) to use. Secondly, when asked to provide a 1 to 5 rating on the potential of the barrier to impact clinical workflow, from “significantly worsen” to “significantly improve,” 63.9% reported “improve” or “significantly improve,” and 33.7% answered “no change.” Ultimately, the overall workflow impact score was a mean (sd) of 3.8 (0.9) and only 6 (4.9%) of individuals negatively rated the work flow impact caused by the use of the aseptic stethoscope diaphragm barrier.

**Table 2**

1.	Have you participated in this survey before?				
	Yes 0%	No 100%			
2.	What is your clinical profession?				
	RN (n=68) 46.3%	MD (n=38) 25.8%	NP (n=13) 8.8%	PA (n=3) 2.0%	Other (n=25) 17.0%
3.	Which statement describes your experience applying a Disk Cover to your stethoscope?				
	Very hard 0.0%	Hard 1.6%	Not Hard or Easy 4.9%	Easy 32.8%	Very Easy 60.7%
4.	Compared to disposable stethoscopes, your stethoscope with a Disk Cover performs.				
	Much worse 0.0%	Slightly worse 0.0%	No difference 14.8%	Slightly better 18.0%	Much better 67.2%
5.	How often do you clean your stethoscope with alcohol for 60 secs (per CDC recommendations)?				
	After each pt 41.8%	After a few pts 9.8%	Daily 16.4%	Weekly 14.8%	Never 18%
6.	Does the Disk Cover system impact your workflow?				
	Sig disrupt 0.0%	Slightly disrupt 4.9%	No impact 33.1%	Slightly improve 24.6%	Sig. improve 39.3%
7.	As an alternative to cleaning between patients, how do you think the Disk Cover system will impact STETHOSCOPE HYGIENE COMPLIANCE among medical staff?				

	Sig worsen 0.0%	Slightly worsen 0.0%	No impact 4.9%	Slightly improve 32.8%	Sig improve 60.7%
8.	How do you think the Disk Cover system will impact PATIENT SAFETY?				
	Sig worsen 0.0%	Slightly worsen 0.0%	No impact 4.9%	Slightly improve 32.8%	Sig improve 60.7%
9.	Where is the Disk Covers system best placed for optimum workflow and stethoscope hygiene compliance?				
	As close to the pt as possible 41.0%	Outside the pt's room 19.7%	In the same place as hand hygiene 26.2%	At the nurse's station 8.2%	Other 3.3%
10.	Based on your experience with the Disk Cover system, and as compared to your current practice, do you see applicability of touch-free dispensing as valuable, for other infection vectors (ultrasound probes, hands, etc)?				
	Absolutely not 0.0%	No 4.9%	Maybe 24.6%	Yes 34.4%	Absolutely yes 34.4%

Totals may not equal 100% as not all subjects answered all questions

P<sub>t</sub> = patient, Sig = significantly

Participant impressions as to the impact of the barrier system to potentially improve both stethoscope and patient hygiene were rated on a 5-point scale from “significantly worsen” to “significantly improve.” These answers reflected a general impression that barriers will improve stethoscope hygiene and patient safety, with a mean (sd) response of 4.6 (0.7) and 4.9 (0.7), respectively. Overall, 93.5% of respondents felt that both stethoscope hygiene and patient safety would be “improved” or “significantly improved” using a barrier. Only 9 (4.9%) subjects felt that the barrier would not improve either stethoscope hygiene or patient safety.

Because disposable stethoscopes are frequently substituted for a practitioner’s personal stethoscope in instances where hygiene issues are critical (e.g., intensive care unit), respondents were asked to indicate if the barrier “significantly worsens” to “significantly improves” stethoscope utility vs. a disposable stethoscope using a 5-point scale. Their mean (sd) rating was 4.6 (0.7), with 85.0% providing a rating that the barrier on their personal stethoscope “improves,” or “significantly improves” stethoscope function vs. the disposable stethoscope.

We also investigated the self-reported frequency of CDC compliant stethoscope cleaning (60 second diaphragm cleaning with 70% isopropyl alcohol swabs), from “after each patient,” to “never.” Only 94 (64.0%) of practitioners chose to provide answer to this query. The most frequent answer was “after each patient”, reported in only 41.8%. “After a few patients”, and “daily” stethoscope cleaning rates were reported by 9.8% and 16.4% of participants. This was followed by “weekly,” “monthly”, or “never”, in 14.8%, 9.8%, and 8.2% of responses in each category, respectively.

Finally, practitioners were asked as to where the best clinical location for placement of a barrier dispenser would be, with answers ranging from “as close to the patient as possible” to as far away as the “nursing station.” The frequency of responses correlated with distance between the barrier dispenser and the patient. The most common answer was “as close to the patient as possible” in 41.0%, followed by the “hand hygiene station” in 26.2%, and “outside the

patient’s room” in 19.7%. Only 3.3% preferred the barrier dispenser to be at the nurse’s station.

## Discussion

We identified that the majority of practitioners expressed that the use of a touch-free aseptic stethoscope diaphragm barrier dispensing system was easy to use and did not disrupt their workflow. Almost all users felt that the touch-free stethoscope barrier dispenser system improved stethoscope hygiene and would serve as an overall improvement to patient safety. Since healthcare associated infections result in significant annual morbidity and mortality, this latter effect may also potentially improve patient outcomes. The fact that no study has ever demonstrated adequate stethoscope hygiene suggests an alternative to the “just wash it” strategy is needed [12]. In prior studies, health care providers have suggested that the lack of stethoscope hygiene is a result of a lack of readily available materials, an absence of visual reminders, a concern of stethoscope damage, and a lack of time; all factors potentially improved by a touch free stethoscope barrier dispenser system [29]. In the current time sensitive nature of medical practice, impediments to workflow could defeat the implementation of new technologies. The findings from this study, that most users perceive a benefit of a touch free aseptic stethoscope diaphragm barrier system and that it improves both workflow and patient safety, suggest that if it was implemented in clinical practice, its use would be unlikely to be resisted by practitioners.

Stethoscope barriers have only recently become available as part of the armamentarium against healthcare associated infection. This is an important consideration, as the stethoscope shares the same microbiome as of the unwashed hands, and thus represents a significant patient care hygiene improvement opportunity. The failure to provide a clean stethoscope may negate the benefits of hand hygiene, thus an intervention with a barrier presents the opportunity to maintain a clean contact that can further potentiate hand hygiene efforts. Other alternatives to stethoscope barriers exist. The disposable stethoscope, although inexpensive, is a dysfunctional tool. One study of 220 auscultation opportunities evaluated the

incidence of misdiagnoses occurring because of the use of the disposable stethoscope. They found that diastolic murmurs were the most commonly missed event, and that these misdiagnoses were not infrequent, resulting in a number needed to harm of only 11 patients. This is unacceptable in the context that 0% misdiagnosis occurred in the same study by physicians using a quality stethoscope with a barrier instead of a disposable stethoscope.

Recent data suggest that the CDC guidelines, suggesting weekly cleaning unless the stethoscope is visibly soiled, need to be updated, as effective alternatives are now available [30]. Since stethoscope cleaning does not eliminate all pathogens on the diaphragm (alcohol swabs are not effective against *C. diff* spores), and in the absence of any study documenting an acceptable stethoscope hygiene rate, it is time to consider the stethoscope barrier as a reasonable alternative.

### Limitations

As this was a voluntary quality improvement survey, we cannot comment on the impact on patient outcomes or infection transmission risks. However, previous studies have demonstrated that the stethoscope barrier is highly effective at reducing the potential for microbial transmission. Additionally, while we reported results of self-reported stethoscope hygiene habits, others have consistently demonstrated a discontinuity between self-reported cleaning rates and the rates recorded when practitioners are unaware that their hygiene performance is being observed (with blinded rates being half that of self-reported rates). What this suggests is that the 38% report of stethoscope hygiene occurring between all patient encounters is likely to be inflated in our analysis. Other limitations include that our questionnaire provided only self-reported data, has not been validated as an accurate impression analysis tool, and only physicians represented 1/3 of our evaluated cohort. However, in the US, the majority of a patient's stethoscope contacts are by nurses or non-physician health care staff, such that our population is an accurate representation of a patient's stethoscope exposure. Finally, with only first-user questionnaire responses included in this analysis, the impact of experience over time of using a touch free stethoscope barrier dispenser cannot be determined accurately and we cannot comment whether an experiential efficiency would occur with practice. However, with the majority of participants rating the experience as "very easy" or "easy," ease of use is not likely to worsen with serial usage.

### Abbreviations

CDC: Center for Disease Control and Prevention

SD: Standard Deviation

### Conclusion

The use of a touch-free aseptic stethoscope barrier system was reported to improve perceived patient safety while simultaneously improving practitioner workflow in this end-user survey.

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