COMMENTARY

Battling Entropy in Infection Control Systems

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(See the article by Staines et al on pages 1420–1427.)

Entropy: The degree of disorder or uncertainty in a system.[1] *The most stable state of every system is that of maximum entropy, so that if left alone any system tends over time towards disorder and chaos. It takes the application of external energy to reduce entropy and bring order back.*

In this issue of *Infection Control and Hospital Epidemiology*, Dr Staines et al[2] present the results of a well-organized, multifaceted, 18-month hand hygiene improvement collaborative project with a 12-month postimplementation assessment. A consortium of 5 Swiss hospitals participated, each setting up implementation teams that focused on systems optimization, education, data collection and feedback, leadership, and "sustainability engineering," a set of interventions aimed at maintaining the effect of their interventions after the project was completed. Their results were impressive. With somewhat modest improvements in systems (eg, the availability of bedside alcohol hand rub dispensers increased from 45% at baseline to 68% at the end of the intervention phase) and training (eg, the perception of having been trained in the past 3 years increased from 52% to 65%), their measured adherence to the Five Moments of Hand Hygiene as defined by the World Health Organization went from 62% at baseline to 88% at the end of the collaborative and 89% 12 months later.

Is it too good to be true? Maybe. The collaborative centered its efforts on establishing a learning environment, on robust data feedback to frontline staff, and on leadership engagement. These are powerful tools. I suspect there was also some healthy interfacility competition, providing an additional stimulus to perform well as a group. Unfortunately, observations were done in every inpatient unit, only in a 4-hour block every 2 months, only during regular daytime shifts, and in an open manner, followed by feedback sessions. I can see a team of observers showing up with clipboards and creating a very significant Hawthorne effect that became potentiated with every repeated bimonthly visit and feedback session. What happened between observations, or in evening or weekend shifts? It would have been interesting to correlate this improvement with other surrogate markers such as product utilization. It would have been even more powerful to have observed a concurrent decline in the transmission of marker organisms such as a specific endemic multidrug-resistant organism or *Clostridium difficile*.

In psychology, the theory of planned behavior[3] maintains that the intention to perform a certain action is influenced by three main factors: (1) the attitude toward the behavior, derived from the belief that the behavior is connected to the intended outcome and the sense of its value (do you believe that hand hygiene is important in preventing transmission of infection?); (2) the "social norm," or the individual's perception that the intended behavior is important to others whose opinion is important to him or her (eg, What do others think when you wash or fail to wash your hands?); and (3) the degree of control that the individual has over the intended behavior (eg, How easy is it is to wash your hands every time you should?). When applied to hand hygiene, investigators have found that ease to perform hand hygiene was most important, followed closely by social pressure. It follows that improving the availability of hand hygiene products at the bedside and favoring water-free products enhances adherence. But the issue of creating social norms around hand hygiene is much more difficult and less developed. When designing hand hygiene interventions, it is critical to identify those whose opinion moves the behavior of healthcare personnel (HCPs). For example, do you care about patient perceptions on how safely you care for them? Do you care about what your peers or trainees or supervisors think if you do or do not wash your hands? Do you care about how your institution compares to others? These questions most certainly have multiple answers. The next step involves establishing hand hygiene as a priority to those individuals. If an attending physician makes it clear to his or her trainees that he or she expects them to sanitize their hands every time they enter and exit a patient's room and models the behavior, they will likely do it (at least when the attending is watching). Likewise, if the attending physician does not follow the rules and does not place any sense of importance on it, trainees are likely to follow. If patients expect HCP to sanitize their hands prior to touching them and are empowered to call them out if it does not happen, HCP will be more likely to do it. These motivators are powerful and important to

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pursue, but they occur at a micro level within an institution and are prone to considerable heterogeneity from one individual to another. Therefore, it is just as important to find institutional motivators. This includes a sense of identity, pride, accomplishment, and competition. The Swiss collaborative created an environment in which the hospital's executive leadership was trained and engaged and supported the infection control process beyond the time that the project was completed. It created clear leadership expectations and developed appropriate systemic incentives and deterrents.

Sustainability is among the most significant challenges for infection control interventions. Optimally, we should set up a good system, train our staff, and after a few cycles of optimization set it in auto-pilot and move on to other priorities. My experience in infection control—and I suspect that of most hospital epidemiologists and infection preventionists—shows otherwise. Entropy. Adherence to infection control practices by frontline staff tend to decline over time unless there is a continuous and concerted effort to maintain it. We engage in a never-ending cycle of recurrent educational activities, continued vigilance and monitoring, data feedback, and system redesign in a perpetual loop that can never be left unattended. In this age of short attention spans, shifting priorities, emerging infections, and resource constrains, the challenge is to be able to sustain the sense of priority and resource allocation to a specific intervention, especially when it seems to "be under control." I believe that the study centers' ability to maintain their institutional focus on an intensive hand hygiene improvement project for almost 3 years is noteworthy, and it may be the most salient part of this study. Did the Swiss collaborative create a self-sustaining system? No. Even though the implementation phase of the collaborative was completed, each hospital created infrastructure and practices that needed to be actively maintained. The implementation phase included organizational and leadership expectations that hand hygiene efforts would continue after the project was finished. Utilization of resources, time, and political capital continued.

To fight the inevitable tendency toward increasing entropy in infection control systems, it is imperative to find internal and external, micro and macro motivators that support sustained institutional focus and resource allocation.

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