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## Major article

## Cost-effectiveness of a hand hygiene program on health care–associated infections in intensive care patients at a tertiary care hospital in Vietnam

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## Key Words:

Hand hygiene  
 Hospital-acquired infection  
 Antibiotic resistance  
 Low- and middle-income country  
 Vietnam  
 Cost-effectiveness

**Background:** The cost-effectiveness of a hand hygiene (HH) program in low- and middle-income countries (LMICs) is largely unknown. We assessed the cost-effectiveness of a HH program in a large tertiary Vietnamese hospital.

**Methods:** This was a before and after study of a hand hygiene program where HH compliance, incidence of hospital-acquired infections (HAIs), and costs were analyzed. The HH program was implemented in 2 intensive care and 15 critical care units. The program included upgrading HH facilities, providing alcohol-based handrub at point of care, HH campaigns, and continuous HH education.

**Results:** The HH compliance rate increased from 25.7% to 57.5% ( $P < .001$ ). The incidence of patients with HAI decreased from 31.7% to 20.3% ( $P < .001$ ) after the intervention. The mean cost for patients with HAI was \$1,908, which was 2.5 times higher than the costs for patients without an HAI. The mean attributable cost of an HAI was \$1,131. The total cost of the HH program was \$12,570, which equates to a per-patient cost of \$6.5. The cost-effectiveness was estimated at  $-\$1,074$  or  $\$1,074$  saved per HAI prevented. The intervention remained cost savings under various scenarios with lower HAI rates.

**Conclusion:** The HH program is an effective strategy in reducing the incidence of HAIs in intensive care units and is cost-effective in Vietnam. HH programs need to be encouraged across Vietnam and other LMICs.

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Programs that produce a sustained improvement in hand hygiene coincide with a reduction of hospital-acquired infections (HAIs) and a reduction in the transmission of health care–associated pathogens such as methicillin-resistant *Staphylococcus aureus* (MRSA), *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*.<sup>1,2</sup>

Successful hand hygiene programs that lead to significant improvement of hand hygiene compliance usually include a continuous education program and installation of accessible dispensers at the point of care (bedside) with alcohol-based

handrub.<sup>3,4</sup> Reductions in HAIs of at least 36% have been achieved in different studies since implementation of an alcohol-based handrub program.<sup>3,4</sup>

Several studies have shown that hand hygiene is a cost-effective method for preventing HAIs.<sup>5,6</sup> It has been estimated that the total cost of hand hygiene promotion corresponds to  $<1\%$  of the costs associated with HAIs.<sup>7</sup> A study examined the effects of a standardized hand hygiene program on the rate of HAIs in very low birth weight infants and showed that the number of HAIs reduced significantly from 18.8% (16/85) to 6.3% (5/80), equivalent to 10 episodes of HAIs per year after the introduction of a standardized hand hygiene protocol, and saved \$10,000 per HAIs.<sup>8</sup>

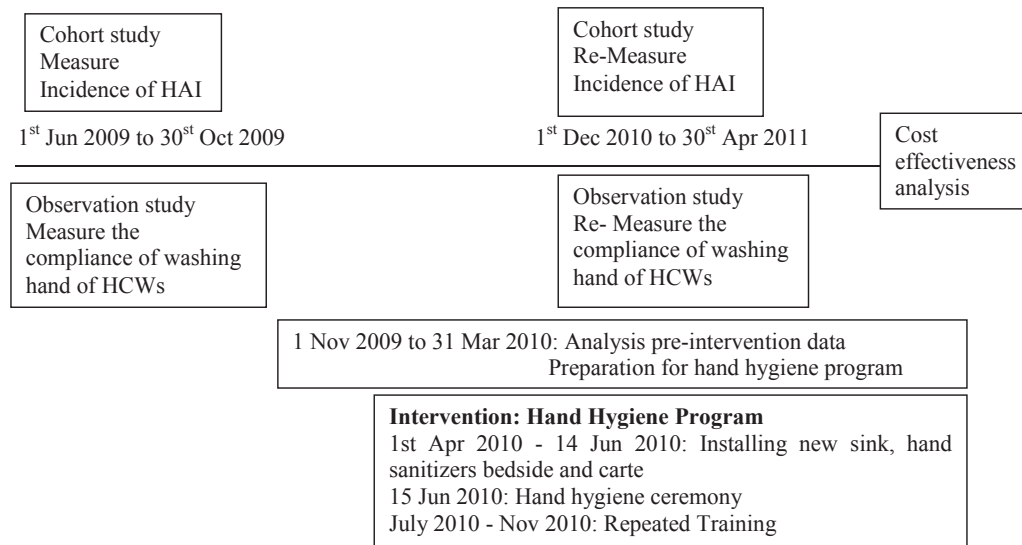
As in other low and middle income countries (LMICs), hospitals in Vietnam are dealing with inadequate resources in hospital infrastructure, limited awareness, and a lack of infection control measures. Handwashing in between patients is usually not

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**Fig 1.** Schema of study. HAI, hospital-acquired infection; HCW, health care worker.

performed because of the lack of hand hygiene facilities and limited awareness. A study to investigate the situation of hand hygiene in 12 general hospitals (3 central hospitals, 5 provincial hospitals, and 4 district hospitals) in Northern Vietnam in 2005 showed that the percentage of patient rooms with sinks was just 37.6%.<sup>9</sup> Furthermore, only 20% of sinks had dry towels. An observation of staff from medical wards of 9 general hospitals showed that on average 6.1% of staff washed their hand before examining patients, 13.4% washed their hands in between patients, and 14.7% washed their hands between clean and dirty procedures on the same patient.<sup>9</sup>

Cho Ray Hospital is a 1,750-bed tertiary university hospital with an occupancy rate up to 143%, resulting in an average daily census of approximately 2,700 patients in 2010. HAI prevalence in Cho Ray Hospital was 5.8%, with a higher prevalence of 22.8% in the intensive care unit (ICU) and critical care unit (CCU) in 2010.<sup>10</sup> HAI is most commonly caused by gram-negative bacteria, such as *P aeruginosa*, *Klebsiella* spp, and *Acinetobacter* spp. There is a big gap in knowledge, attitude, and behavior among hospital staff: 96.7% think handwashing is necessary to reduce HAI, but only 56.7% said that they washed their hands.<sup>11</sup>

The rate of hand hygiene compliance was reported to be as low as 20% in Cho Ray Hospital.<sup>12</sup> An increase of hand hygiene compliance was shown to be related to a reduction in surgical site infections on the surgical department.<sup>13</sup> A study in 1999 at Cho Ray Hospital estimated that the cost of HAIs was \$1,248,192, approximately 8.2% of the annual total hospital budget that year (Cho Ray Hospital report). Currently, it is unknown whether a hand hygiene program is cost-effective in a LMIC. In this study we aim to assess the effectiveness of a hand hygiene program through evaluating the impact of this program on reducing HAI in ICUs and CCUs, increasing level of compliance with hand hygiene by health care workers (HCWs), and cost-effectiveness.

## METHODS

### Design

This is a before and after study with a hand hygiene program as the intervention. We compared the compliance rate of hand hygiene and the incidence of HAIs before and after the intervention, and we included a cost analysis. The study was approved by the Cho Ray Hospital Ethical Committee.

### Study site and population

Cho Ray Hospital is a 1,750-bed tertiary university hospital based in Ho Chi Minh City, Vietnam, with a bed occupancy rate of up to 143%, resulting in an average daily census of approximately 2,700 patients in 2010. It is one of the largest hospitals in Vietnam, with all specialties, and it is a referral hospital for other hospitals. The study was conducted in 2 main ICUs and 15 CCUs (7 CCUs in internal medicine departments and 8 CCUs in 8 surgery departments).

### Intervention

The hand hygiene program in the studied wards started on April 1, 2010, and was maintained afterward. The contents of the program included a ceremony with a quiz on hand hygiene for all HCWs of the hospital and a continuous hand hygiene education program for HCWs using posters, flyers, and seminars. HCWs were educated on the importance of hand hygiene and the right handwashing technique through in-service workshops. The World Health Organization's (WHO's) My 5 Moments of Hand Hygiene were used as the key moments for HCWs' handwashing at our hospital.<sup>14</sup> Hand hygiene education was also provided to patients and their families admitted to the ICUs and CCUs. Appropriate hand hygiene stations were installed, including new sinks, hand disinfectant solutions, and disposable towel dispensers. Alcohol-based handrub was provided in 500-mL wall-mounted and bed-mounted dispensers for use by HCWs at the point of care. Additional handrub dispensers were also installed on medication and treatment carts. Portable 100-mL bottles were provided for nursing staff and doctors working in studied units to carry in their pockets.

The schedule of study was described in [Figure 1](#).

### Outcome variables

The outcome variables included hand hygiene compliance and the incidence of HAIs during hospitalization. HAIs were classified by site of infections, including nosocomial pneumonia, surgical site infections, urinary tract infections, bloodstream infections, skin infections, and others.

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