

Healthcare-associated infections can cause severe illness. A trust switched from using chlorine-based products to sporicidal wipes to cut rates of C difficile

Tackling C difficile with environmental cleaning

In this article...

- Why the trust changed from chlorine-based products to sporicidal wipes for environmental cleaning
- How a project to test the effectiveness of sporicidal wipes was designed and implemented
- The reduction in C difficile infection rates during and after the study period

Authors Yvonne Carter is service lead nurse infection prevention and control; Deborah Barry is clinical lead nurse infection prevention and control; both at The Royal Free Hampstead NHS Trust, London.

Abstract Carter Y, Barry D (2011) Tackling C difficile with environmental cleaning. *Nursing Times*; 107: 36, 22-25.

Background Chlorine-based cleaning products are often used in acute settings for high-level disinfection of the environment to help control C difficile. However, these products must be used at high concentrations, making them irritant, toxic and corrosive. This means they are inappropriate for the near-patient environment, and can lead to user resistance and non-compliance. More recently, products using peracetic acid and hydrogen peroxide have become available, which are highly effective even under conditions of heavy soiling.

Aim To determine whether peracetic acid sporicidal wipes could help reduce rates of C difficile at an acute London trust.

Method An observational study of C difficile rates was carried out at an acute London trust between 2006 and 2010. All

inpatients aged two years and over were monitored. Chlorine-based cleaning regimens and products were changed to peracetic acid sporicidal wipes in April 2008 and monitored for 18 months. Inpatient bed days were also monitored to ensure findings were not affected by changing patient numbers.

Results The mean C difficile rate per 1,000 patients fell from six to two following the 2008 introduction of the sporicidal wipes. In the first half of 2009, this rate dropped to below two. The overall rate of C difficile infection was reduced by 72% following the introduction of the wipes.

Conclusion The introduction of sporicidal wipes resulted in a significant reduction in C difficile rates. This supports the need to review and enhance traditional environmental cleaning regimens for preventing and controlling C difficile in acute settings

Introduction

C difficile infection (CDI) can cause severe illness and suffering, particularly for older people, those on antibiotics, and people with debilitating illnesses.

Antibiotics can disturb normal gut

5 key points

1 The most effective ways to prevent C difficile infection are: focused antibiotic management, handwashing, patient isolation, and effective environmental cleaning

2 Chlorine-based cleaning products are widely used to reduce rates of C difficile in acute trusts

3 Chlorine-based products must be used at high concentrations to be effective, making them irritant, toxic and corrosive

4 Sporidical wipes contain peracetic acid, which breaks down into vinegar, carbon dioxide and water when the wipes are wet. They are environmentally friendly, safe for use close to

patients, and can be used on all fabrics

5 Using sporicidal wipes for environmental cleaning can help significantly reduce rates of C difficile infection



Scanning electron micrograph of C difficile

flora, allowing *C difficile* to produce toxins that cause diarrhoea and colitis. CDI is also transmitted by spores, which contaminate the environment and can be resistant to cleaning. The most effective tools to prevent and tackle CDI are:

- » Focused antibiotic management to reduce gut disturbance;
- » Handwashing, rather than alcohol gel or rub, when caring for patients with diarrhoea;
- » Isolation of patients with diarrhoea to contain the source of CDI;
- » Effective environmental cleaning to reduce transmission from contaminated surfaces (Dancer, 2009; Department of Health, 2008a; 2007).

Chlorine-based products are part of a standard range of measures used for environmental cleaning to reduce rates of *C difficile* in acute trusts (DH and Health Protection Agency, 2008). However, to really drive down rates of infection, rather than just maintain control of *C difficile*, cleaning products must be reviewed and improved where appropriate.

This article describes the introduction of peracetic acid-releasing sporicidal wipes into the environmental cleaning regimen of an acute London trust, and the subsequent observed reduction in CDI rates.

Background

C difficile spores can survive in the environment for months or even years, across a range of surfaces and equipment used in patient care. The contaminated environment is a major source for CDI acquisition (DH, 2008a; Pratt et al, 2007).

Chlorine-based products have traditionally been used for high-level disinfection, largely because of a lack of practical alternatives able to kill bacterial spores and other resistant organisms. To be effective, chlorine-based products must be used at concentrations high enough to deliver reliable sporicidal activity. However, at these concentrations they are irritant, toxic and corrosive, making them inappropriate for the near-patient environment. This can also lead to user resistance and non-compliance. More recently, products using peracetic acid and hydrogen peroxide have become available. Peracetic acid is highly effective against vegetative bacteria and viruses, and shows rapid sporicidal activity even under conditions of heavy soiling (Center for Disease Control, 2008; Wilcox et al, 2003).

Following screening trials, the trust decided to replace existing chlorine-based protocols with wipes which, when wet,

release peracetic acid and hydrogen peroxide. The reaction takes place on the wipes so they are safe to use in the near patient environment, and have minimal adverse impact on the user.

Method

The study started in April 2006, with the sporicidal wipes introduced in April 2008. All patients aged two years and over admitted to the Royal Free Hampstead Trust were included in the study.

CDI cases were identified using DH and Health Protection Agency definitions (DH, 2008b), and only cases occurring 48 hours after admission were included in the study. More than one case for the same patient was counted if there was a 28-day period between samples, and symptoms had resolved during this time. Diarrhoea was defined as:

- » Stool loose enough to take on the shape of its container (Bristol Stool Chart 5-7; tinyurl.com/stoolchart);
- » Not attributable to any other causes;
- » Occurring at the same time as a positive toxin assay (Lewis and Heaton, 1997).

Occupied bed-day data was collected weekly so that any fall or rise of CDI rates could not be attributed to changes in patient numbers.

Sporicidal wipes

Before the sporicidal wipes were introduced, the trust used chlorine-releasing agents for cleaning in cases of suspected or actual infectious diarrhoea as recommended by the DH (2007).

However, these agents can be unpopular with users because of irritating fumes, and dilution and preparation issues. They can also damage furnishings and equipment (CDC, 2008). An effective sporicidal alternative was therefore sought, based on the following criteria:

- » Specific proven sporicidal activity;
- » User-friendly format;
- » Environmentally friendly with non-toxic fumes;
- » Would not damage furnishings and equipment;
- » Had non-selective action so would not promote microbial resistance.

The Clinell Sporicidal wipe manufactured by Gama Healthcare Ltd UK (www.gamahealthcare.com) was chosen. The wipe contains peracetic acid, one of the safest, most effective bactericidal, sporicidal and viricidal agents (CDC, 2008; Medical Devices Agency, 2002).

After the wipes were introduced, users said they were preferable to chlorine as

they were easier to handle, and easy to activate and use in practice. The peracetic acid breaks down into vinegar, carbon dioxide and water, making them environmentally friendly, and since they do not produce toxic fumes they are safe to be used in close proximity to patients. The wipes contain no alcohol or organic solvents, so they can be used on all fabrics.

The sporicidal wipe also works in highly soiled conditions. Unlike chlorine, there is no need to pre-clean areas, saving valuable time. Unlike many chlorine-based products that need carefully measured dilution or are complex to make up before use, the wipes are ready immediately on contact with water.

Peracetic acid is delivered on demand at the site, and as the wipes provide a non-selective action there is no risk of microbial resistance. The wipes can also be easily stored within the ward environment.

Project implementation

The sporicidal wipes were ordered and delivered every month to the infection prevention and control (IPC) nurses. To ensure efficient and effective use, the nurses then distributed them on a case-by-case basis.

A member of the IPC team also visited every patient identified as CDI-positive to discuss their care face to face. A pack was taken directly to the bedside which included:

- » Two packets of 25 sporicidal wipes;
- » The sporicidal wipe information sheet;
- » Patient information sheet on CDI;
- » Individualised patient care plan;
- » CDI care pathway with a wall-mounted poster for staff information.

Training

Ward staff were taught how to activate the dry sporicidal wipes with water, and how to clean the patient environment with the wipes. Ward-based cleaners and domestics, housekeepers, and other health professionals involved in direct patient care were also trained how to use the wipes, as they are equally important in maintaining a clean environment (Eckstein et al, 2007).

Training included daily environmental cleaning of horizontal surfaces, patient furniture, toilet facilities, bed frames, commodes, and medical equipment, such as infusion pumps. Frequent touch points, such as door handles, taps and light switches were also cleaned.

The wipes were also used for terminal cleaning, following the discharge or transfer of patients with CDI, and for cleaning equipment after use throughout the day. Teaching was reinforced on

annual, mandatory IPC updates for all clinical staff and allied health professionals, and was included on IPC awareness days for all trust staff. Individual ward visits by the IPC nurses included discussions with staff, and matrons were sent flyers and newsletters to further disseminate information on the wipes to other clinical staff.

Ward rounds

All patients identified with CDI were visited on weekly ward rounds by an IPC team, including IPC nurses, a microbiologist, and an antimicrobial pharmacist. This was to ensure good practice and to deliver fresh supplies of sporicidal wipes.

Ward staff were reminded that the wipes are for single-patient use only, and that if a patient's symptoms resolve and they are discharged, unused wipes should be discarded and not used in any other area or with any other patient.

Three months after the sporicidal wipes were introduced, weekly multidisciplinary ward rounds were introduced to monitor infection prevention and control measures and patient care. Sporidical wipe availability, use and environmental cleaning was also audited. When the ward rounds were introduced, awareness of the specific environmental cleaning required for patients who are isolated with known CDI, and use of the sporicidal wipes, was 70% among clinical and cleaning staff. This is now 100%.

Increased awareness has been achieved by incorporating information about isolation room cleaning, specifically relating to CDI patients, into teaching sessions and mandatory IPC annual updates for nursing staff. Domestic staff have also received targeted teaching.

As CDI rates markedly improved at the trust, ward staff recognised the benefit of the wipes and started to contact the IPC nurses to request them. Additionally, clinical units such as endoscopy, X-ray and theatres requested wipes for cleaning areas following investigations and procedures on patients with CDI, or possible infectious diarrhoea.

Results

Data was collected on the number of cases of CDI and the number of occupied beds in the hospital. It was necessary to know how many patients were in hospital at any given time so that any fall or rise in CDI would not be attributed to changes in patient numbers.

CDI case numbers and bed occupancy were provided from April 2006 to September 2009. To create a rate, the number

TABLE 1. C DIFFICILE INFECTION RATE PER 1,000 PATIENTS

Mean average rate								
Month	2006-07		2007-08		2008-09*		2009-10*	
	Number of observations	Mean avg rate per 1,000	Number of observations	Mean avg rate per 1,000	Number of observations	Mean avg rate per 1,000	Number of observations	Mean avg rate per 1,000
April	4	4.82	4	6.20	4	3.41	4	1.20
May	4	5.93	4	8.94	4	0.86	5	1.27
June	4	6.65	4	8.71	5	1.45	4	1.32
July	5	4.30	5	7.75	4	2.23	4	1.66
Aug	4	3.79	4	7.52	4	2.31	5	2.71
Sept	4	6.70	5	6.56	4	3.51	1	1.59
Oct	5	7.81	4	4.83	4	2.93		
Nov	4	8.64	4	15.52	5	2.96		
Dec	5	8.26	5	4.34	4	0.40		
Jan	4	6.20	4	2.90	4	1.68		
Feb	4	6.28	4	6.41	4	1.66		
March	4	5.50	5	5.20	5	1.26		

*New cleaning product introduced

TABLE 2. AVERAGE C DIFFICILE RATE BY YEAR

Mean and median C difficile rate by year			
Financial year	Number of weeks	Mean C difficile rate	Median C difficile rate
2006-07	51	6.27	5.54
2007-08	52	6.99	5.95
2008-09	51	2.05	1.74
2009-10	23	1.66	1.59

of cases was divided by the number of patients occupying beds. This was then multiplied by 1,000 to get a rate per thousand patients a week (Table 1).

The distribution of CDI rates by year was also investigated (Fig 1). The study results show the spread of CDI rates was much higher in the two years before 2008-09, with a particularly wide range of infection rates in 2007-08 (Fig 2). The results also show the mean and median infection rates are much lower in 2008-09 and 2009-10 than in the preceding two years, with a significant drop in infection rates from 2008-09 onwards (Table 2).

Before the sporicidal wipes were introduced in April 2008, a chlorine-based cleaning product was used. The study results show that CDI rates were significantly lower after the introduction of the wipes.

The annual supply of peracetic acid wipes cost £6,566. The cost per patient for CDI is around £4,000 (Song et al, 2008;

Wilcox et al, 1996). When the cost per patient is multiplied by the reduction in cases in 2008-09, compared with 2007-08, the cost saving is £660,000. We acknowledge that other variables that were not part of the study may have contributed to this saving.

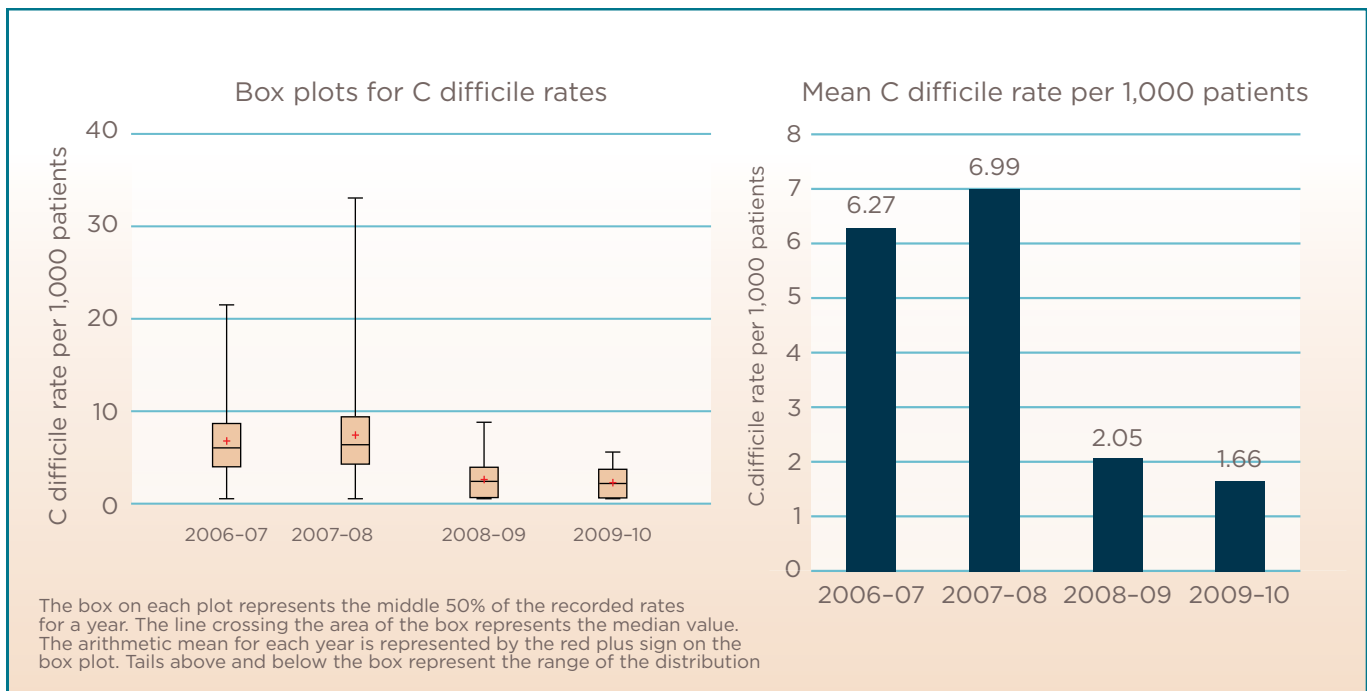
Discussion

Reports of investigations into outbreaks of *C difficile* at Stoke Mandeville Hospital and Maidstone and Tunbridge Wells Trust said environmental cleaning was a major area where improvements could have been made (Healthcare Commission, 2007; Health and Safety Executive, 2006). This provided a focus for the trust to improve its CDI rates.

The study was limited to observing a reduction in CDI rates following introduction of the sporicidal wipes, and some variables were not measured. These include the introduction of the IPC ward rounds and the influence of focused training for using the sporicidal wipes (previous training for use of chlorine products was limited to general induction). Isolation practices, patient care and antibiotic regimens related to CDI management did not change during the study period, nor did the method for collecting stool samples and laboratory testing for *C difficile*.

IPC meetings

Before the sporicidal wipes were introduced, rates of CDI were reported at fortnightly IPC meetings to clinical, divisional, nursing, operational and medical leads.



This practice has continued and has been an essential forum for key trust staff. It is chaired by the director of IPC who leads the trust's IPC programme.

Costs

It is difficult to compare the costs of the wipes and the original chlorine-based product because of the frequent, ineffective use of the chlorine.

This was through dilution, wastage, or staff non-compliance because the product was not user-friendly. The annual cost of the chlorine-based product was less than the cost of the wipes, but the savings from the reduction in CDI rates was vastly greater. This has been sustained. Where changing from chlorine products to sporicidal wipes incurs a cost increase, sustained reductions in CDI rates must be measured alongside expenditure to demonstrate financial savings, and improvements in patient care.

Support

The root cause of CDI must be analysed to ensure clinical care aspects, as well as environmental cleanliness issues, are addressed. This article describes observed reductions in CDI rates following introduction of peracetic acid sporicidal wipes, but also describes the support required to implement the initiative which can be applied to any healthcare setting.

Manufacturer of the wipes provided support at IPC awareness days, and gave information to IPC nurses. This included advice on packaging, printed documents,

and product acceptability information. Dispensers for the wipes are provided and fitted to trust specifications.

Conclusion

Strategies to prevent and control CDI must include a range of IPC measures. This study has demonstrated how one intervention can have a positive impact on CDI rates.

Continual monitoring to maintain the momentum of the intervention proved important in fostering staff ownership, and ensuring sustained use of the sporicidal wipes. CDI rates for the trust have fallen by more than 70%, and the improvement has been sustained. The cost savings demonstrated during the study have underlined the benefits of investigating and implementing improvement processes, such as the change to sporicidal wipes for environmental cleaning. These wipes are an invaluable investment in reducing CDI rates, and improving patient safety and quality of care. **NT**

References

- Center for Disease Control (2008) *Guideline for Disinfection and Sterilization in Healthcare Facilities*. Atlanta, GA: CDC.
- Dancer SJ (2009) The role of environmental cleaning in the control of hospital-acquired infection. *Journal of Hospital Infection*; 73: 4, 378-385.
- Department of Health and Health Protection Agency (2008) *C. difficile Infection: How to Deal with the Problem*. London: DH and HPA. [Tinyurl.com/HPA-CDI](http://tinyurl.com/HPA-CDI)
- Department of Health (2008a) *Clean, Safe Care: Reducing Infections and Saving Lives*. London: DH. tinyurl.com/DH-clean-safe

- Department of Health (2008b) *CMO letter: Changes to Mandatory Healthcare Associated Infection Surveillance System for C. difficile Infection (CDI) from 1st January 2008*. tinyurl.com/CMO-letter-2008
- Department of Health (2007) *Saving Lives: Reducing Infection, Delivering Clean and Safe Care*. London: DH. tinyurl.com/DH-saving-lives
- Eckstein BC et al (2007) Reduction of C. difficile and vancomycin-resistant Enterococcus contamination of environmental surfaces after an intervention to improve cleaning methods. *BMC Infectious Diseases*; 7: 61.
- Health and Safety Executive (2006) *HSE Investigation into Outbreaks of C. difficile at Stoke Mandeville Hospital, Buckinghamshire Hospitals NHS Trust*. London: HSE. tinyurl.com/HSE-Stoke-Mandeville
- Healthcare Commission (2007) *Investigation into Outbreaks of C. difficile at Maidstone and Tunbridge Wells NHS Trust*. London: HCC. tinyurl.com/HCC-Maidstone
- Health Protection Agency (2008) *Changes to HCAI Mandatory Enhanced Surveillance in English NHS and Independent Sector Hospitals*. London: HPA.
- Lewis SJ, Heaton KW (1997) Stool form scale as a useful guide to intestinal transit time. *Scandinavian Journal of Gastroenterology*; 32: 9, 920-924.
- Medical Devices Agency (2002) *Sterilisation, Disinfection and Cleaning of Medical Equipment: Guidance on Decontamination from the Medical Advisory Committee to Department of Health*. London: MDA. tinyurl.com/MDA-decontamination
- Pratt RJ et al (2007) Epic 2: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. *Journal of Hospital Infection*; 65: S13-15.
- Song X et al (2008) Rising economic impact of Clostridium difficile-associated disease in adult hospitalised patient population. *Infection Control Hospital Epidemiology*; 29:9, 829-831.
- Wilcox MH et al (1996) Financial burden of hospital-acquired C. difficile infection. *Journal of Hospital Infection*; 34: 1, 23-30.
- Wilcox MH et al (2003) Comparison of the effect of detergent versus hypochlorite cleaning on environmental contamination and incidence of C. difficile infection. *Journal of Hospital Infection*; 54: 109-114.

Tackling C difficile with environmental cleaning

从环境清洁入手解决艰难梭菌的问题

In this article...

Why the trust changed from chlorine-based products to sporicidal wipes for environmental cleaning

How a project to test the effectiveness of sporicidal wipes was designed and implemented

The reduction in C difficile infection rates during and after the study period

在这篇文章中……

为什么医院会从含氯消毒剂换成了过氧乙酸消毒巾进行环境清洁与消毒

如何设计和实施一个项目来测试过氧乙酸消毒巾杀芽孢的有效性

艰难梭菌感染率在研究期间和之后的减少

Background

Chlorine-based cleaning products are often used in acute settings for high-level disinfection of the environment to help control C difficile. However, these products must be used at high concentrations, making them irritant, toxic and corrosive. This means they are inappropriate for the near-patient environment, and can lead to user resistance and non-compliance. More recently, products using peracetic acid and hydrogen peroxide have become available, which are highly effective even under conditions of heavy soiling.

背景

含氯消毒剂的清洁产品经常用于急症医院环境的高水平消毒，以帮助控制艰难梭菌。然而，这些产品必须在高浓度下使用，在高浓度时具有刺激性、毒性和腐蚀性。这意味着它们不适合接近病人的环境，并可能导致用户的抗拒和低依从性。最近，使用过氧乙酸和过氧化氢的产品已经出现，即使在严重污染的情况下也非常有效。

Aim

To determine whether peracetic acid sporicidal wipes could help reduce rates of C difficile at an acute London trust.

目的

确定过氧乙酸消毒巾是否有助于降低艰难梭菌感染发病率。

Method

An observational study of C difficile rates was carried out at an acute London trust between 2006 and 2010. All inpatients aged two years and over were monitored. Chlorine-based cleaning regimens and products were changed to peracetic acid sporicidal wipes in April 2008 and monitored for 18 months. Inpatient bed days were also monitored to ensure findings were not affected by changing patient numbers.

方法

2006年至2010年间，一项艰难梭菌率的观察性研究在伦敦急症信托医院机构进行。所有两岁及以上的住院病人都接受了监测。2008年4月，以含氯消毒剂的清洁方法和产品被改为过氧乙酸消毒巾，并进行了18个月的监测。还监测了住院天数，以确保检查结果不受患者人数变化的影响。

Results

The mean C difficile rate per 1,000 patients fell from six to two following the 2008 introduction of the sporicidal wipes. In the first half of 2009, this rate dropped to below two. The overall rate of C difficile infection was reduced by 72% following the introduction of the wipes.

结果

在 2008 年引入过氧乙酸消毒巾后，每 1000 名患者的平均艰难梭菌感染率从 6 下降到 2。2009 年上半年，这一比率降至 2 以下。使用过氧乙酸消毒巾后，艰难梭菌的总感染率降低了 72%。

Conclusion

The introduction of sporicidal wipes resulted in a significant reduction in C difficile rates. This supports the need to review and enhance traditional environmental cleaning regimens for preventing and controlling C difficile in acute settings

结论

采用过氧乙酸消毒巾后，艰难梭菌感染率显著降低。这支持需要审查和加强传统的环境清洁方案，以预防和控制急性医院环境中的艰难梭菌。

Introduction

C difficile infection (CDI) can cause severe illness and suffering, particularly for older people, those on antibiotics, and people with debilitating illnesses.

介绍

艰难梭菌感染(CDI)可导致严重的疾病和痛苦，特别是对老年人、那些服用抗生素的病人和患有较重疾病体弱的病人。

Antibiotics can disturb normal gut flora, allowing C difficile to produce toxins that cause diarrhoea and colitis. CDI is also transmitted by spores, which contaminate the environment and can be resistant to cleaning. The most effective tools to prevent and tackle CDI are:

抗生素会干扰正常的肠道菌群，使得艰难梭菌产生毒素，导致腹泻和结肠炎。艰难梭菌感染可通过孢子（芽孢）传播，孢子会污染环境，而且会产生抗药性。预防和解决艰难梭菌感染最有效的工具是：

reduce gut disturbance;

» Handwashing, rather than alcohol gel or rub, when caring for patients with diarrhoea;

» Isolation of patients with diarrhoea to contain the source of CDI;

» Effective environmental cleaning to reduce transmission from contaminated surfaces (Dancer, 2009; Department of Health, 2008a; 2007).

减少肠道紊乱;

护理腹泻病人时，应洗手，而不是用酒精凝胶或搓揉;

隔离腹泻患者，以控制艰难梭菌感染的来源;

有效的环境清洁以减少污染表面的传播 (Dancer, 2009; Department of Health, 2008a; 2007)。

Chlorine-based products are part of a standard range of measures used for environmental cleaning to reduce rates of C difficile in acute trusts (DH and Health Protection Agency, 2008). However, to really drive down rates of infection, rather than just maintain control of C difficile, cleaning products must be reviewed and improved where appropriate.

含氯消毒剂是用于环境清洁的标准系列措施的一部分，以减少急症信托医疗机构的艰难梭菌感染率(DH and Health Protection Agency, 2008)。然而，为了真正降低感染率，而不是仅仅维持对艰难梭菌的控制，清洁产品必须在适当的地方进行评估和改进。

This article describes the introduction of peracetic acid-releasing sporicidal wipes into the environmental cleaning regimen of an acute London trust, and the subsequent observed reduction in CDI rates.

本文介绍了在急症伦敦信托医院的环境清洁方案中引入过氧乙酸消毒巾，以及随后观察到的艰难梭菌感染率的降低。

Background

C difficile spores can survive in the environment for months or even years, across a range of surfaces and equipment used in patient care. The contaminated environment is a major source for CDI acquisition (DH, 2008a; Pratt et al, 2007).

背景

艰难梭菌可以在环境中生存数月甚至数年，在病人的护理过程中，艰难梭菌可污染一系列的物体表面和设备表面。污染环境是艰难梭菌感染的主要来源。

Chlorine-based products have traditionally been used for high-level disinfection, largely because of a lack of practical alternatives able to kill bacterial spores and other resistant organisms. To be effective, chlorine-based products must be used at concentrations high enough to deliver reliable sporicidal activity. However, at these concentrations they are irritant, toxic and corrosive, making them inappropriate for the near-patient environment. This can also lead to user resistance and non-compliance. More recently, products using peracetic acid and hydrogen peroxide have become available. Peracetic acid is highly effective against vegetative bacteria and viruses, and shows rapid sporicidal activity even under conditions of heavy soiling (Center for Disease Control, 2008; Wilcox et al, 2003).

传统上，含氯消毒剂用于高水平消毒，主要是因为缺乏能够杀死细菌孢子和其他耐药微生物的实用替代品。为了有效，含氯消毒剂必须使用浓度足够高，提供可靠的杀孢子活性。然而，在这些浓度下，它们是刺激性的、有毒的和腐蚀性的，使它们不适合接近病人的环境。这也会导致用户的抵制和使用依从性低。最近，使用过氧乙酸和过氧化氢的产品已经出现。过氧乙酸对细菌和病毒有很强的杀灭作用，即使在重污染环境下也能表现出快速的杀孢子活性 (Center for Disease Control, 2008; Wilcox et al, 2003)。

Following screening trials, the trust decided to replace existing chlorine-based protocols with wipes which, when wet, release peracetic acid and hydrogen peroxide. The reaction takes place on the wipes so they are safe to use in the near patient environment, and have minimal adverse impact on the user.

经过筛选试验后，该信托医院决定用过氧乙酸消毒巾取代现有的含氯消毒剂，当伽玛的过氧乙酸消毒干巾遇水，则产生新鲜的过氧乙酸和过氧化氢。这种反应发生在湿巾上，所以它们可以安全的在附近的病人环境中使用，对使用者的负面影响也很小。

Method

The study started in April 2006, with the sporicidal wipes introduced in April 2008. All patients aged two years and over admitted to the Royal Free Hampstead Trust were included in the study.

方法

这项研究始于 2006 年 4 月，2008 年 4 月引入了伽玛过氧化乙酸消毒巾。所有年龄在两岁以上的皇家汉普斯特德自由信托基金会(Royal Free Hampstead Trust)患者均纳入研究。

CDI cases were identified using DH and Health Protection Agency definitions (DH, 2008b), and only cases occurring 48 hours after admission were included in the study. More than one case for the same patient was counted if there was a 28-day period between samples, and symptoms had resolved during this time. Diarrhoea was defined as:

艰难梭菌感染病例是根据卫生署和卫生保护局的定义确定的(DH, 2008b)，并且只将入院 48 小时后发生的病例纳入研究。如果样本之间有 28 天的时间间隔，那么同一患者的病例数就会超过 1 例，并且在此期间症状已得到缓解。腹泻的定义如下：

- » Stool loose enough to take on the shape of its container (Bristol Stool Chart 5-7; tinyurl.com/stoolchart);
- » Not attributable to any other causes;
- » Occurring at the same time as a positive toxin assay (Lewis and Heaton, 1997).

大便足够松，在便盆容器里可以铺满容器(Bristol Stool Chart 5-7; tinyurl.com/stoolchart);
不可归责于其他原因的;
与阳性毒素测定同时发生(Lewis and Heaton, 1997)。

Occupied bed-day data was collected weekly so that any fall or rise of CDI rates could not be attributed to changes in patient numbers.

被占用的卧床日数据每周收集一次，因此艰难梭菌感染率的任何下降或上升都不能归因于患者人数的变化。

Sporicidal wipes

Before the sporicidal wipes were introduced, the trust used chlorine-releasing agents for cleaning in cases of suspected or actual infectious diarrhoea as recommended by the DH (2007)

过氧化乙酸消毒巾（杀芽孢消毒巾）

在引入过氧化乙酸消毒巾前，信托基金曾按卫生署(2007)的建议，使用含氯消毒剂清洁与消毒怀疑或实际感染腹泻的病例的周围环境表面。

However, these agents can be unpopular with users because of irritating fumes, and dilution and preparation issues. They can also damage furnishings and equipment (CDC, 2008). An effective sporicidal alternative was therefore sought, based on the following criteria:.

然而，由于刺激性气体、稀释和配制问题，这些制剂可能不受用户欢迎。它们还会损坏家具和设备(CDC, 2008)。因此，根据下列标准，寻求一种有效的杀孢子备选方案：

- » Specific proven sporicidal activity;
- » User-friendly format;
- » Environmentally friendly with non-toxic fumes;
- » Would not damage furnishings and equipment;

» Had non-selective action so would not promote microbial resistance.

特定的已证实的杀孢子活性;

»对用户友好;

具有无毒气体的环境友好型;

不会损坏家具和设备;

具有非选择性作用，因此不会促进微生物的耐药性。

The Clinell Sporicidal wipe manufactured by Gama Healthcare Ltd UK (www.gamahealthcare.com) was chosen. The wipe contains peracetic acid, one of the safest, most effective bactericidal, sporicidal and viricidal agents (CDC, 2008; Medical Devices Agency, 2002).

由英国伽玛公司生产的 Clinell 过氧乙酸消毒巾被选择用来替代含氯消毒剂进行高水平消毒。该消毒巾主要含过氧乙酸，过氧乙酸是目前最有效的杀细菌和杀病毒且最安全的高水平消毒剂之一（CDC, 2008; Medical Devices Agency, 2002）

After the wipes were introduced, users said they were preferable to chlorine as they were easier to handle, and easy to activate and use in practice. The peracetic acid breaks down into vinegar, carbon dioxide and water, making them environmentally friendly, and since they do not produce toxic fumes they are safe to be used in close proximity to patients. The wipes contain no alcohol or organic solvents, so they can be used on all fabrics.

在推出过氧乙酸消毒巾后，操作者表示，过氧乙酸消毒巾比含氯消毒剂更好用，因为它们更容易使用，更容易激活，也更容易在实践中使用。过氧乙酸会分解成醋酸、二氧化碳和水，因此对环境无害。由于它们不会产生有毒气体，所以在病人附近使用是安全的。这种消毒巾不含酒精或有机溶剂，所以可以用在所有的纤维材质上。

The sporicidal wipe also works in highly soiled conditions. Unlike chlorine, there is no need to pre-clean areas, saving valuable time. Unlike many chlorine-based products that need carefully measured dilution or are complex to make up before use, the wipes are ready immediately on contact with water.

这种过氧乙酸消毒巾也适用于高度污染的环境。不像含氯消毒剂那样要先对表面进行清洁再进行消毒，节省宝贵的时间。不像许多含氯消毒剂需要仔细测量稀释后的浓度，或者在使用前需要复杂的配制，消毒巾一接触水就可以立即使用。

Peracetic acid is delivered on demand at the site, and as the wipes provide a non-selective action there is no risk of microbial resistance. The wipes can also be easily stored within the ward environment.

过氧乙酸是现场按需提供的，由于过氧乙酸消毒巾提供了非选择性的作用，所以没有微生物耐药性的风险。过氧乙酸消毒巾可以很容易地存储在病房环境中。

Project implementation

The sporicidal wipes were ordered and delivered every month to the infection prevention and control (IPC) nurses. To ensure efficient and effective use, the nurses then distributed them on a case-by-case basis.

项目实施

每个月都会给感染预防和控制(IPC)护士订购并发放过氧乙酸消毒巾。为了确保有效和有效的使用，护士们将它们按病列分发。

A member of the IPC team also visited every patient identified as CDI-positive to discuss their care face to face. A pack was taken directly to the bedside which included:

IPC 小组的一名成员还对每一位确诊为艰难梭菌感染阳性的患者进行了面对面的沟通。一个包裹被直接送到病人床边，包裹内包括:

- » Two packets of 25 sporicidal wipes;
- » The sporicidal wipe information sheet;
- » Patient information sheet on CDI;
- » Individualised patient care plan;
- » CDI care pathway with a wall-mounted poster for staff information.

2 包 25 抽过氧乙酸消毒巾;

过氧乙酸消毒巾信息表;

艰难梭菌感染患者信息表;

个性化的病人护理计划;

墙上贴着海报，海报内容包括艰难梭菌感染病人的护理路径以供医务人员参阅。

Training

Ward staff were taught how to activate the dry sporicidal wipes with water, and how to clean the patient environment with the wipes. Ward-based cleaners and domestics, housekeepers, and other health professionals involved in direct patient care were also trained how to use the wipes, as they are equally important in maintaining a clean environment (Eckstein et al, 2007).

培训

病房工作人员被告知如何用清水激活干的过氧乙酸消毒巾，以及如何用湿巾清洁消毒病人的环境。以病房为中心的清洁工、相关工作人员和其他直接护理病人的卫生专业人员也接受了如何使用过氧乙酸消毒巾的培训，因为过氧乙酸消毒巾在维持清洁环境方面很重要

Training included daily environmental cleaning of horizontal surfaces, patient furniture, toilet facilities, bed frames, commodes, and medical equipment, such as infusion pumps. Frequent touch points, such as door handles, taps and light switches were also cleaned.

培训内容包括日常环境表面清洁，病人家具，厕所设施，床架，马桶，和医疗设备，如输液泵。经常接触的地方，如门把手、水龙头和电灯开关等也被清洁。

The wipes were also used for terminal cleaning, following the discharge or transfer of patients with CDI, and for cleaning equipment after use throughout the day. Teaching was reinforced on annual, mandatory IPC updates for all clinical staff and allied health professionals, and was included on IPC awareness days for all trust staff. Individual ward visits by the IPC nurses included discussions with staff, and matrons were sent flyers and newsletters to further disseminate information on the wipes to other clinical staff.

过氧乙酸消毒巾也用于艰难梭菌感染患者出院或转移后的终末消毒，以及全天后使用后的设备清洁与消毒。所有临床工作人员和专职卫生专业人员在每年的强制性感控学习中都要重新接受培训，并将其列入所有工作人员的感控宣传日。感控护士的病房巡视包括与工作人员的讨论，并向工作人员发送传单和通讯，以便进一步向其他临床工作人员传播有关过氧乙酸消毒巾的信息。

Ward rounds

All patients identified with CDI were visited on weekly ward rounds by an IPC team, including IPC nurses, a microbiologist, and an antimicrobial pharmacist. This was to ensure good practice and to deliver fresh supplies of sporicidal wipes.

查房

感控小组每周要对所有确诊为艰难梭菌感染的病人进行查房，感控小组成员包括感控护士、微生物学家和抗菌药物药剂师。查房的目的是为了确保感控措施的良好实施以及能保证提供新鲜的过氧乙酸消毒巾。

Ward staff were reminded that the wipes are for single-patient use only, and that if a patient's symptoms resolve and they are discharged, unused wipes should be discarded and not used in any other area or with any other patient.

病房工作人员被提醒，过氧乙酸消毒巾只供单一病人使用，如果病人的症状缓解，出院后，不用的湿巾应该丢弃，不能用于任何其他地方或与其他病人一起使用。

Three months after the sporicidal wipes were introduced, weekly multidisciplinary ward rounds were introduced to monitor infection prevention and control measures and patient care. Sporicidal wipe availability, use and environmental cleaning was also audited. When the ward rounds were introduced, awareness of the specific environmental cleaning required for patients who are isolated with known CDI, and use of the sporicidal wipes, was 70% among clinical and cleaning staff. This is now 100%.

在采用过氧乙酸消毒巾三个月后，每周进行多学科查房以监测感染预防和控制措施和病人护理。还对过氧乙酸消毒巾的可用性、使用和环境清洁进行了审核。进行病房查房后，在临床和保洁人员中，对已知的艰难梭菌感染隔离患者所需的特定环境进行清洁和使用过氧乙酸消毒巾的意识为从原来的 70% 上长升为现在的 100%

Increased awareness has been achieved by incorporating information about isolation room cleaning, specifically relating to CDI patients, into teaching sessions and mandatory IPC annual updates for nursing staff. Domestic staff have also received targeted teaching.

通过将有关隔离病房清洁的信息，特别是与艰难梭菌感染患者相关的信息，纳入护理人员的教学课程和强制性的感控年度更新，提高了医务人员的认识。清洁人员也接受了针对性的教学。

As CDI rates markedly improved at the trust, ward staff recognised the benefit of the wipes and started to contact the IPC nurses to request them. Additionally, clinical units such as endoscopy, X-ray and theatres requested wipes for cleaning areas following investigations and procedures on patients with CDI, or possible infectious diarrhoea.

随着艰难梭菌感染率评分在信托机构医院的显著提高，病房工作人员认识到过氧乙酸消毒巾的好处，并开始联系感控护士，要求他们提供过氧乙酸消毒巾。此外，临床科室，如内镜室、x 光检查室和手术室，在对艰难梭菌感染患者或可能的感染性腹泻患者进行调查和诊疗后，要求用过氧乙酸消毒巾清洁消毒患者可能污染的区域。

Results

Data was collected on the number of cases of CDI and the number of occupied beds in the hospital. It was necessary to know how many patients were in hospital at any given time so that any fall or rise in CDI would not be attributed to changes in patient numbers.

结果

收集艰难梭菌感染病例数及医院床位占用数。有必要知道在任何时候有多少病人住院，这样艰难梭菌感染的任何下降或上升都不会归因于病人数量的变化。

CDI case numbers and bed occupancy were provided from April 2006 to September 2009. To create a rate, the number of cases was divided by the number of patients occupying beds. This was then multiplied by 1,000 to get a rate per thousand patients a week (Table 1).

2006年4月至2009年9月期间提供了艰难梭菌感染病例编号和床位占用情况。为了创建一个比率，用病例数除以占用床位的病人数。然后乘以1000，得到每周每千名病人的感染率(表1)。

The distribution of CDI rates by year was also investigated (Fig 1). The study results show the spread of CDI rates was much higher in the two years before 2008-09, with a particularly wide range of infection rates in 2007-08 (Fig 2). The results also show the mean and median infection rates are much lower in 2008-09 and 2009-10 than in the preceding two years, with a significant drop in infection rates from 2008-09 onwards (Table 2).

艰难梭菌感染率的分布按年度进行调查(图1)。研究结果显示艰难梭菌感染的传播率在2008-09年的前两年要高得多,尤其是2007-08年度的感染率特别高(图2)。结果还表明2008-09年和2009-10年感染率均值和中位数比前两年低得多,从2008-09年开始感染率显著下降(表2)。

Before the sporicidal wipes were introduced in April 2008, a chlorine-based cleaning product was used. The study results show that CDI rates were significantly lower after the introduction of the wipes.

在2008年4月引入过氧乙酸消毒巾之前，使用了一种含氯消毒剂作为清洁消毒产品。研究表明，引入过氧乙酸消毒巾后，艰难梭菌感染率明显降低。

The annual supply of peracetic acid wipes cost £6,566. The cost per patient for CDI is around £4,000 (Song et al, 2008; Wilcox et al, 1996). When the cost per patient is multiplied by the reduction in cases in 2008-09, compared with 2007-08, the cost saving is £660,000. We acknowledge that other variables that were not part of the study may have contributed to this saving.

每年供应的过氧乙酸消毒巾花费6566英镑。每位艰难梭菌感染患者的费用约为4000英镑(Song et al, 2008; Wilcox et al, 1996)。当每位病人的费用乘以2008-09年度病例数与2007-08年度相比的减少的感染人数，节省费用为66万英镑。我们知道，不属于研究的一部分的其他变量，可能有助于节省这些费用。

Discussion

Reports of investigations into outbreaks of *C. difficile* at Stoke Mandeville Hospital and Maidstone and Tunbridge Wells Trust said environmental cleaning was a major area where improvements could have been made (Healthcare Commission, 2007; Health and Safety Executive, 2006). This provided a focus for the trust to improve its CDI rates.

讨论

斯托克曼德维尔医院、梅德斯通和滕布里奇维尔信托医院对艰难梭菌爆发的调查报告称，环境清洁是可以改进的一个主要方向(Healthcare Commission, 2007; Health and Safety Executive, 2006)。这为信托医院更好的控制艰难梭菌感染率提供了一个重点方向。

The study was limited to observing a reduction in CDI rates following introduction of the sporicidal wipes, and some variables were not measured. These include the introduction of the IPC ward rounds and the influence of focused training for using the sporicidal wipes (previous training for use of chlorine products was limited to

general induction). Isolation practices, patient care and antibiotic regimens related to CDI management did not change during the study period, nor did the method for collecting stool samples and laboratory testing for *C. difficile*.

这项研究的局限性在于仅限于观察在使用过氧乙酸消毒巾后艰难梭菌感染率的降低，一些变量未被测量。这些变量包括感控查房、集中培训如何使用过氧乙酸消毒巾(以前使用含氯消毒剂的培训仅限于一般的介绍)。在研究期间，与艰难梭菌感染管理相关的隔离措施、患者护理和抗生素方案没有改变，收集粪便样本和艰难梭菌实验室检测的方法也没有改变。

IPC meetings

Before the sporicidal wipes were introduced, rates of CDI were reported at fortnightly IPC meetings to clinical, divisional, nursing, operational and medical leads.

感控会议

在采用过氧乙酸消毒巾之前，每两周召开一次的感控会议，向临床、科室、护理、操作和医疗主管报告艰难梭菌感染的发病率。

This practice has continued and has been an essential forum for key trust staff. It is chaired by the director of IPC who leads the trust's IPC programme.

这种做法一直在继续，并成为主要信托医院工作人员的重要论坛。委员会由感控主任担任主席，由他领导信托基金医院的感控方案。

Costs

It is difficult to compare the costs of the wipes and the original chlorine-based product because of the frequent, ineffective use of the chlorine.

成本

由于经常无效地使用含氯消毒剂，因此很难比较过氧乙酸消毒巾和原来的含氯消毒剂的成本。

This was through dilution, wastage, or staff non-compliance because the product was not user-friendly. The annual cost of the chlorine-based product was less than the cost of the wipes, but the savings from the reduction in CDI rates was vastly greater. This has been sustained. Where changing from chlorine products to sporicidal wipes incurs a cost increase, sustained reductions in CDI rates must be measured alongside expenditure to demonstrate financial savings, and improvements in patient care.

因为产品对用户不友好，所以导致产品配制时被稀释、浪费和低的依从性。含氯消毒剂的年成本低于过氧乙酸消毒巾的成本，但过氧乙酸消毒巾降低艰难梭菌感染率所节省的成本要大得多，这是持续的。如果从含氯消毒剂改为过氧乙酸消毒巾会增加成本，则必须同时衡量艰难梭菌感染率的持续下降，以证明财政节约和病人护理的改善。

Support

The root cause of CDI must be analysed to ensure clinical care aspects, as well as environmental cleanliness issues, are addressed. This article describes observed reductions in CDI rates following introduction of peracetic acid sporicidal wipes, but also describes the support required to implement the initiative which can be applied to any healthcare setting.

支持

必须分析艰难梭菌感染的根本原因，以确保解决临床护理方面以及环境清洁问题。这篇文章描述了在使用过氧乙酸消毒巾后艰难梭菌感染率的降低，但也描述了实施这一计划所需的支持，它可以应用于任何医疗保健环境。

Manufacturer of the wipes provided support at IPC awareness days, and gave information to IPC nurses. This included advice on packaging, printed documents, and product acceptability information. Dispensers for the wipes are provided and fitted to trust specifications.

过氧乙酸消毒巾制造商在感控宣传日提供支持，并向感控护士提供信息。这包括关于包装、印刷文件和产品可接受性信息的建议。提供了过氧乙酸消毒巾的分配器，并符合可靠的规范。

Conclusion

Strategies to prevent and control CDI must include a range of IPC measures. This study has demonstrated how one intervention can have a positive impact on CDI rates.

结论

预防和控制艰难梭菌感染的战略必须包括一系列感控措施。这项研究表明了一种干预方法如何对艰难梭菌感染率产生积极影响。

Continual monitoring to maintain the momentum of the intervention proved important in fostering staff ownership, and ensuring sustained use of the sporicidal wipes. CDI rates for the trust have fallen by more than 70%, and the improvement has been sustained. The cost savings demonstrated during the study have underlined the benefits of investigating and implementing improvement processes, such as the change to sporicidal wipes for environmental cleaning. These wipes are an invaluable investment in reducing CDI rates, and improving patient safety and quality of care.

持续监测，保持干预的动力，并确保持续使用具有杀芽孢作用的消毒巾，对医院员工来说非常重要。信托医院的艰难梭菌感染率已经下降了 70% 以上，而且这种改善是持续的。在研究期间所显示的成本节约，突出了调查和实施改进过程的好处，例如为环境清洁更换为过氧乙酸消毒巾。这种消毒巾是降低艰难梭菌感染率、改善患者安全和护理质量的宝贵投资。