Association among Personal and Institutional Hygienic Factors with Acute Gastroenteritis in Hong Kong Elderly Homes

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ABSTRACT (IN ENGLISH)

Abstract of thesis entitled: Association among Personal and Institutional Hygienic Factors with Acute Gastroenteritis in Hong Kong Elderly Homes

Background & Objective: Acute gastroenteritis (AG) outbreak in elderly homes is common in Hong Kong, especially during the winter. Although mainly a self-limiting condition, the associated short-term as well as long-term medical and social costs can be extensive. This case-control study aims to investigate the hygienic risk factors related to infectious AG in elderly homes at both institutional and individual levels. Predictor variables under investigation include hand wash practice, infection control practice, routine institutional hygienic practice, food handling practice, and environmental factors such as the home setting, ventilation measures and isolation room setting.

Methods: All the elderly homes in the New Territories East were invited to take part in the study. A total of 34 homes and 2,995 residents were recruited in the study sample. The data collection period was from Dec 2007 to May 2009. Cases were notified within one week after a reported AG case, either by a report from the elderly home in question, the weekly check up with the New Territories East Community Geriatric Assessment Teams (NTE CGATs), regular contact with the elderly homes by the research assistant and case referrals from the Accident and Emergency Department from the Prince of Wales Hospital (PWH). One hundred and forty cases and 280 matched controls were recruited. For every AG case reported, two sex and age (within 5 years) and elderly home matched controls were selected. Structured questionnaires were conducted in face-to-face interviews in the elderly homes by trained interviewers. Information about

the ventilation and the environmental hygiene of the elderly homes was collected by observation from the research team at the beginning of the study. Descriptive analysis was performed for the characteristics of cases and controls. Multivariate and multilevel logistic regression models were applied and odds ratios (ORs) were calculated for the potential hygienic risk factors.

Results: Multiple conditional logistic regression analysis revealed 'sometimes or never wash hands after toilet' OR:3.09 (95%CI: 1.28 – 7.42) [ref gp: wash hands every time after toilet] was the major significant risk factor for AG in elderly homes, indicating the possible route of person-to-person transmission. Other significant risk factors included: Self-nutrition evaluation as 'not enough' (OR: 2.07; 95%CI: 1.05 – 4.06), 'Being hospitalized in past month before the interview' (OR: 2.86; 95%CI: 1.16 – 7.05), 'Simplified Barthel Index scored <15" (OR: 2.63; 1.06 – 6.53), and 'Alzheimer's' (OR: 2.75; 95% 1.18 – 6.40). The institutional hygiene factors were investigated based on the descriptive analysis between the outbreak homes (OHs) and the non-outbreak homes (NOHs). The results indicated that the health worker (HW) to resident ratio was much lower in OHs than NOHs (50% OHs: 1:30-55 vs > 80% NOHs:1:10-29), and a higher percentage of the NOHs had a more frequent routine cleaning practice than the OHs.

Conclusions: This study found that 'sometimes or never wash hands after toilet' was a significant personal hygienic risk factor for AG transmission. This indicated that toilet may be the most susceptible place and hands are the most susceptible vehicle for AG transmission in Hong Kong elderly homes. A higher percentage of the NOHs had a more

frequent routine cleaning practice than the OHs, demonstrating that routine cleaning practice may be an economical and an effective way to prevent AG infection.

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ABSTRACT (IN CHINESE)

個人衞生和院舍清潔衞生之危險因素與香港老人院急性腸胃炎的關係

背景及目的: 急性腸胃炎爆發在香港老人院十分普遍，此疾病尤其活躍於冬天。雖然急性腸胃炎爲可控制的疾病，但它亦可爲社會帶來龐大的醫療開支，以及生活上的負擔。本研究採用病例對照研究，旨在探討個人衞生及老人院的清潔衞生對引發急性腸胃的危險因素。本研究之預測變量爲先手習慣、感染控制政策、日常院舍之清先操施、食物處理操施、和環境因素: 包括院舍設計、通風系統和隔離室設施。

方法: 所有新界東的老人院均被邀請參與是次研究，是次研究共邀得三十四間老人院、共二千九百九十五名老人院院友參加，本研究之研究期爲二零零七年十二月至二零零九年五月。每一宗急性腸胃炎個案需於一星期內呈報，呈報方法分別爲由老人院職員呈報、每星期與社區老人評估小組人員聯絡、定期由研究組與老人院聯絡或由威爾斯親王醫院急症室轉介個案。是次研究收集了一百四十個個案和二百八十個相對對照組。每一宗急性腸胃炎個案均會隨機配合兩位對照院友，對照院友必需與個案年齡相差不大於五年及擁有相同性別。由受訓的訪問員採用結構性問卷，通過當面詢問方法收集數據。有關老人院的通風和環境衞生情況的數據會於研究開始時由研究組觀察記錄(詳情見第三章)。本研究利用描述性分析去敍述個案和對照院友的特徵，採用多因素方法以及多項邏輯回歸方法去統計每個被提議危機因素的比值比。

結果：利用多項邏輯回歸方法分析出 ‘如廁後間中或沒有洗手’組別 [比值比: 3.09(95%CI: 1.28 – 7.42)]; [參考組別: 如廁後每次洗手]爲引致急性腸胃炎的主要危機因素，顯示病毒有機會以人傳人方式傳播。其他顯著的危機因素包括有: ‘自我營養評估爲不足夠’ (OR: 2.07; 95%CI: 1.05 – 4.06), ‘於訪問前一個月內曾經留院’ (OR: 2.86; 95%CI: 1.16 – 7.05), ‘簡化巴氏量表值少於 15’ (OR: 2.63; 1.06 – 6.53), 和‘患有老人痴呆症’ (OR: 2.75; 95% 1.18 – 6.40)。此外，我們亦分析了爆發院舍和非爆發院舍之清潔衞生因素。結果顯示爆發院舍的保健員與院友之人數比例比非爆發院舍之比例爲高，而非爆發院舍比爆發院舍的日常清潔次數也較爲頻密。

結論：本研究之結果得出‘如廁後間中或沒有洗手’爲急性腸胃炎傳染的重要個人衞生危機因素之一。在香港的老人院舍中，此現象顯示洗手間和手部爲最有可能傳播急性腸胃炎的地方和工具。此外，本研究亦得出比較多非爆發院舍的恆常清潔習慣的頻密程度比爆發院舍爲高，這顯示出恆常清潔習慣可能爲一項經濟和有成效的方法去預防急性腸胃炎傳染。

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LIST OF CONTRIBUTORS

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Department	Contributors /	Contributions
Department of Medicine and Therapeutics	Professor Timothy Kwok	Study design and questionnaire development
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Department of Medicine and Therapeutics	Professor Nelson Lee	AG case referral from Prince of Wales Hospital
Sha Tin Hospial Alice Ho Miu Ling Nethersole Hospital (Tai Po) North District Hospital,	Nurses in the three Community Geriatric Assessment Teams	Assistance in subject recruitment and case report

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SELECTED ABBREVIATIONS

AG	Acute gastroenteritis
AED	Accident and emergency department
BMI	Body mass index
CDC	Centers for disease control and prevention
CENO	Central notification office
CGAT	Community geriatric assessment team
CHP	Centre for health protection
DALY	Disability adjusted life year
DH	Department of health
FFQ	Food frequency questionnaire
GI	Gastrointestinal
HIV	Human immunodeficiency virus
HW	Health worker
ICO	Infection control officer
IR	Isolation room
IV	Intravenous
LTCF	Long term care facility
MRSA	Methicillin-resistant *staphylococcus aureus*
NOH	Non-outbreak home
NoV	*Norovirus*
NTE	New Territories East
OH	Outbreak home
OR	Odds ratio
PCW	Personal care worker
PPE	Personal protective equipment
ppm	Parts per million
PWH	Prince of Wales hospital
RCHE	Residential care homes for the elderly
RotaV	*Rotavirus*
RN	Registered nurse
SBI	Simplified barthel index
SD	Standard deviation
SOC	Stages of change
SWD	Social Welfare Department
WHO	World Health Organization

CHAPTER 1
BACKGROUND and OBJECTIVES

1.1 Introduction

The population of Hong Kong is aging rapidly. Life expectancy is projected to reach 82 years for men and 88 years for women by 2031. The current old-age dependency ratio of 16 % is projected to double by 2030. The estimated aging-related spending in term of GDP is also expected to rise from 4% to 8% in 2050 [4] and the aging of the population will lead to a greater demand for long term care facilities such as elderly homes. The Social Welfare Department (SWD) of Hong Kong government is the licensing party of elderly homes. It is governed by the Residential Care Homes (Elderly Persons) Ordinance (Cap.459A Sect 18): The Inspection of Residential Care Homes. Guidelines on hygienic practices and infection control measures in elderly homes are provided by the Centre for Health Protection, under the Department of Health (DH). The Elderly Health Service Team is responsible for education for every case outbreak reported. However, the most common type of outbreak in elderly homes, and one that occurs frequently, is that of acute gastroenteritis (AG) [5]. Its attack rate can be as high as 40 % in Hong Kong [6].

Acute gastroenteritis is a common cause of morbidity and mortality worldwide [7, 8] Diarrhoea related mortality is among the top five causes of death in the world, with 1.7 million deaths annually [9, 10]. Acute gastroenteritis outbreak

in elderly homes is common, especially in the winter season. Though mainly a self-limiting condition, a small proportion of elderly victims develop secondary long-term illnesses and complications. The associated short-term as well as long-term medical and social costs can be extensive [11]. In some extreme cases, the elderly homes have to be closed [6]. The combination of a group living environment, in addition to the age-related factors, facilitates the spread of pathogens through person-to-person transmission.

Norovirus (NoV) and *Rotavirus* (RotaV) are two common pathogens causing viral infections [12]. The major routes of transmission are foodborne and person-to-person transmissions. Aerosolization of viral particles during vomiting and contaminated fomites in the environment have also been suggested as possible sources of infection [13-15]. Individual outbreak cases of AG have been studied extensively in different countries [16-21]. However, no risk factors, especially hygienic risk factors have been concluded. In addition, contaminated food source, improper cooking method, unsatisfactory kitchen environment, the hygienic conditions of utensils and the hygienic practices of the meal distributer are all potential sources of foodborne infection [22].

Besides foodborne infection, hygienic factors also contribute to person-to-person transmission, especially in a group living environment, such as an elderly home. If the hygienic conditions are not well controlled, regular introduction of susceptible persons, such as residents recently discharged from hospital, together

with faecal incontinence, dementia, and the immobility that are common in elderly homes may facilitate extensive contamination of the environment with faecal pathogens [21]. Also, it has been proven empirically that pathogens from contaminated surfaces can be readily transferred to other places via hands and washcloths [23].

Despite routine decontamination efforts, contamination can persist for long periods due to viral resistance, recontamination from prolonged shedding, and non-comprehensive infection control measures [24]. The underling hygienic effect on pathogen transmission is not well studied. Identification of risk factors for the spread of gastroenteritis pathogens in both sporadic and outbreak cases will advance our understanding of AG transmission in elderly homes in Hong Kong.

1.2 Objectives and hypothesis of the study

This study investigates the hygienic risk factors related to infectious AG in elderly homes, at both the institutional and individual levels. The research hypothesis is that poor personal and institutional hygienic factors are associated with acute gastroenteritis in Hong Kong Elderly Homes. This thesis:

(1) Identifies the individual hygienic risk factors, such as the practice of hand washing, changing clothes and bathing behaviours.

(2) Explores the institutional hygienic characteristics, comparing the outbreak and non-outbreak homes, analyzing areas such as the rountine hygienic practice , infection control policy and practice, environmental hygienic conditions, and hygiene in food preparation and handling.

The secondary objectives of the thesis are to:

(1) Determine other individual susceptibility factors, such as medical history, eating habits, lifestyle, medication, and hospital admission.

(2) Verify other institutional chararcteristics over AG infection such as staffing (e.g. staff to resident ratio, sick leave policy, qualifications of staff) and home setting (e.g. resident capacity, toilet to resident ratio, ventilation facilities, and the number and conditions of isolation room (IR) /s).

(3) Investigate the disease burden resulting from sporadics and AG outbreaks, including the symptoms, mediation and treatment, and the economic cost.

1.3 Significance of the study

AG is a preventable infectious disease. Resources focusing on hygienic education and disinfection measurement have been imposed by the Hong Kong government through the use of guidelines, training courses and legislation. Also, the disease burden of AG in elderly homes in Hong Kong is extensive. However, no risk factors are generalized from these policies. This study aims to better understand the aetiology of AG, in particular, the personal and institutional risk factors in this special population. This epidemiology study is critical to provide important data on the associated risk factors and transmission routes and pathogenesis of AG. The findings will help to improve infection control measures in this special setting.

CHAPTER 2
LITERATURE REVIEW

2.1 Epidemiology of acute gastroenteritis

2.1.1 Clinical features and definition

Acute gastroenteritis (AG) refers to the sudden onset of enteric symptoms including diarrhoea, vomiting, abdominal cramps, and nausea. Low-grade fever also occurs occasionally, and vomiting is more common in children [25]. The incubation period usually ranges from a few hours to five days for bacterial diarrhoea and one to two days for viral diarrhoea [26, 27]. AG is a self-limiting disease with dehydration the most common complication, especially among the young and the elderly, and may require medical attention. Symptoms usually last from 24 to 60 hours [12].

Clinical diagnosis does not require an exact definition of AG as it is a symptom-based infectious disease. However, an operational definition is required for epidemiological study for case inclusion and exclusion. Countries that have launched a population-based study to assess the prevalence and the disease burden of AG, have used their own definition. Canada adopted the loosest definition, of any diarrhoea or vomiting [28]; Ireland accepted a single bloody diarrhoea as a case definition [29]; the United States took activity restriction into consideration [30]; and most countries, such as Australia and Malta, included other symptoms like respiratory illnesses, abdominal pain, and fever as part of the definition [31, 32]. Countries shared similar exclusion criteria, with all non-infectious causes like

medications, chronic illness, alcohol consumption or pregnancy cited. Table 2.1 summarizes the case definitions of AG by country of origin.

Different definitions necessarily result in different prevalence and disease burden, making national comparisons difficult [33, 34]. A standard symptom-based case definition was presented at the third Annual Meeting of the International Collaboration on Enteric Disease 'Burden of Illness' Studies [1], and accepted by the representatives from over 20 countries. A case of acute gastroenteritis is defined as one with the victim having 3 or more loose stools, or any vomiting in 24 hour, but excluding non-infectious causes such as cancer of the bowel, irritable bowel syndrome, Crohn's disease, ulcerative colitis, cystic fibrosis, coeliac disease, any chronic illness with symptoms of diarrhoea and vomiting, or symptoms due to drugs, alcohol, or pregnancy. This definition was chosen for its simplicity and acceptability. By applying the standard definition to data from different countries, national comparison on prevalence and disease burden is made possible.

2.1.2 Aetiology

Pathogenesis

Infectious diarrhoea can be classified as inflammatory or non-inflammatory [35]. Non-inflammatory diarrhoea most often results from interference with absorption of fluid and electrolytes and does not involve pathogenic invasion of the intestinal mucosa. Nearly all viral and most protozoan pathogens give rise to non-inflammatory diarrhoea. In most of the cases, pathogens interfere with the absorptive functions of enterocytes in the small intestine through the production of toxins that alter the handling of fluids and electrolytes or cause villous damage. These processes result in the delivery of excess fluid and electrolytes to the large intestine. Once the absorptive capacity of the large intestine is exceeded, a high-volume, watery diarrhoea results. On the other hand, many bacterial pathogens invade the intestinal mucosa provoking an inflammatory response that results in colonic malabsorption and the presence of leukocytes and blood in the stool [2]. Table 2.2 lists the pathogens that cause inflammatory or non-inflammatory diarrhoea.

2.1.3 Pathogen transmission

Pathogens are transmitted primarily through the faecal-oral route, either by consumption of faecally contaminated food or water, or by direct person-to-person spread [15, 36]. In an integrated epidemiological report of *norovirus* outbreaks collected in Europe, among 5,036 outbreaks, 88%(N=4,429) were suspected to be person-to-person outbreaks, 10% (N=506) were food-borne outbreaks and 2% (N=76) were water-borne outbreaks[37]. Environmental and fomite contamination may also act as a

source of infection. Good evidence exists for transmission due to aerosolization of vomitus that presumably results in droplets contaminating surfaces or entering the oral mucosa and being swallowed [14, 38-41]. There is no evidence to suggest infection occurs through the respiratory system [38].

2.1.4 Prevalence

Two hundred and eleven million episodes of AG occur each year in the United States, resulting in over 0.9 million hospitalizations and over 6,000 deaths every year [40]. The range of published rates per 1,000 resident-care days was 0.1-2.5 and the estimated range for total annual number of cases was 0.05-1.37 million [42]. In European countries such as Holland and England, community-based studies have shown that 20%-25% of individuals have one episode of AG annually[43, 44] Based on a similar AG case definition and method of estimation comparing the incidence rate in Western countries[1], the incidence per person-year was the highest in Australia,1.00 (95% CI: 0.88 – 1.10), followed by Canada, 0.91 (95% CI: 0.80-1.02), the United States, 0.83 (95% CI: 0.78 – 0.89), Ireland 0.64 (95% CI: 0.59-0.70), and Malta, 0.37 (95% CI: 0.36-1.89). The incidence in females is higher than in males in all these countries. In Hong Kong, the prevalence of AG reporting rate was 7% in a population-based telephone survey. The corresponding incidence per person-year was found to be 0.91 (95% CI 0.81-1.01) [45]. In Hong Kong, the monthly AG incidence rate in elderly homes is monitored by a surveillance programme run by the Centre for Health Protection, HKSAR involving 50 elderly homes. The average number of elderly people with AG per day per 1,000 residents ranged from 0.05 to 0.68 from Jan 08 – May 09 (Fig. 2.1).

Due to institutional living conditions, AG pathogens can be transmitted more easily by person-to-person transmission in the enclosed spaces in long term care facilities (LTCFs) [46-48]. Data from the United states' Centers for Disease Control and Prevention (CDC) [49] revealed the number and percentage of reported gastroenteritis outbreaks in LTCF in different states, with the percentage that were due to *Norovirus*. In 11 states, more than 50% of the outbreaks came from LTCF. The percentages are as high as 91% and 84% in Colorado and Connecticut, respectively. *Norovirus* was found to be the causative pathogen in every state, contributing 5%-66% of the total outbreak. In the United States, most cases of infectious gastroenteritis go unreported, and the incidence of the disease is based on estimation. On average, adults in the United States and Europe have approximately one episode per year [50]. A study in elderly homes in Maryland, USA showed that 80% of AG outbreaks were due to *Norovirus* [47].

Norovirus causes approximately 90% of epidemic non-bacterial outbreaks of acute gastroenteritis world-wide [51], and is responsible for 50% of all food-borne outbreaks of AG in the US [52]. Another 20% of cases, and the majority of severe cases in children, is due to *Rotavirus*. Other significant viral agents include *Adenovirus* and *Astrovirus* [53]. In 1999, the most common pathogens causing AG in US were *Norovirus* (66.6%), and *Campylobacter spp.* (14.2%). Together with *Salmonella spp.*(9.7%), they contribute over 90% of the cause of AG. Other pathogens also included *Clostridium perfringens*, *Giardia lamblia*, *Staphylococcus aureus*, *Stiga-toxigenic E. coli*, *Shigella* and *Yersinia enterocolitica*. [40] . From 1997

to 2006, 28,576 patients were identified with AG, with 1,622 patients required hospitalization in Hong Kong. The five most common causative pathogens with respect to the total number of patients were *Vibrio papahaemolyticus* (N=5,074), *Non-typhoidal Salmonella spp.* (N=3,218), *Norovirus* (N=1,344) , Ciguatera fish poisoning (N=1,180) and *Staphylococcus aureus* (N=1,001) [54].

Table 2.1 Case definition of AG in different studies among Australia, Canada, Ireland, Malta, and the United States (Adapted from Majowicz SE et al.[1])

Case definition	Inclusion criteria	Exclusion criteria
Australia	. 3 D or . 2 V; or . 4 D or . 3 V when symptoms of respiratory illness are also present in 24 h	Non-infectious causes (e.g. pregnancy, medications, chronic illness, or alcohol consumption
Canada	Any D or V	Chronic causes of D or V (e.g. morning sickness, Crohn's disease, ulcerative colitis)
Ireland	. 3 D; or bloody D; or V with one of D, cramps/abdominal pain, fever in 24 h	Non-infectious causes of D or V, including excess alcohol, morning sickness, Crohn's disease, and ulcerative colitis
Malta	. 3 D or . 3V in 24 h period; or any D or V with . 2 additional symptoms (abdominal cramps, abdominal pain, fever, nausea, blood in stool, mucus in stool)	Pre-existing illness or non-infectious conditions in which vomiting/diarrhoea is a symptom or the concurrent taking of any medications which can cause diarrhoea/vomiting as side effects
United States	. 3 D in 24 h lasting >1 day or resulting in activity restriction	Chronic cases of D (e.g. colitis IBS), or surgical removal of part of stomach or intestines

D: diarrhoea ; V: vomit

Table 2.2 Causes of inflammatory and non-inflammatory diarrhoea (Adapted from Armitage KB & Salata RA [2])

	Non-inflammatory	**Inflammatory**
Location	Small intestine	Large intestine
Diarrheoa	Watery, large volume	Small volume, loose stools, bloody
Pathogens	*Norovirus*	*Shigella* species
	Rotavirus	*Salmonella enteritidis*
	Giardia lamblia	*Campylobacter* species
	Enterotoxigenic Escherichia coli	*Enteroinvasive E.coli*
	Vibrio cholerae	*V. parahaemolyticus*
	Clostridium perfringens	*C.difficile*
	Bacillus cereus	*Entamoeba histolytica*
	Staphylococcus aureus	*Yersinia enterocolitica*
	Cryptosporidium	
	Cyclospora	
	Microsporidium	
	Enterohemorrhagic E. coli	

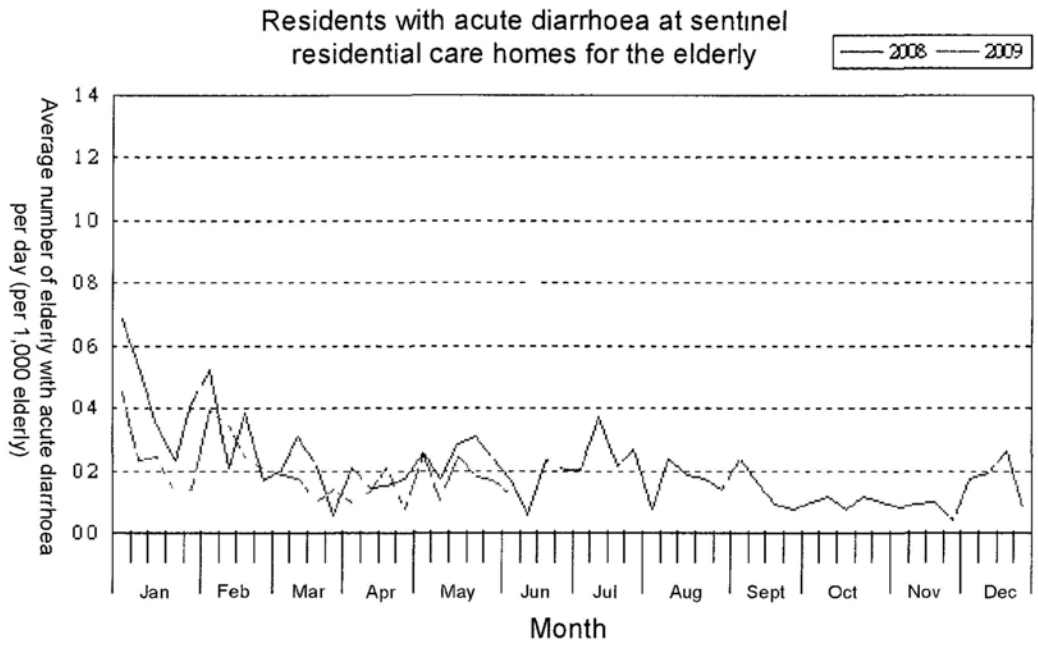

Fig. 2.1 Average number of elderly persons with acute diarrhoea per day (per 1,000 seniors), monitored by a surveillance programme in Hong Kong elderly homes. Adopted from CHP, HKSAR [3]

Underreporting

Underreporting of AG cases is common among community and elderly homes. In the UK, it is estimated that one out of 136 cases of infectious intestinal disease is reported [44]. For a case to be reported to a surveillance system, it must first present to a healthcare facility, the general practitioner must then request and submit a stool sample and a pathogen must be identified. In elderly homes, staff may not report the AG cases, in order to avoid government inspection and residents may not report their AG symptoms to the staff for fear of having to consult a doctor and being sent to the isolation room. As a result, the estimated prevalence may not reflect the actual number of AG cases.

2.1.5 Outbreak cases in elderly homes

Pathogens

With the close proximity of institutional living being a factor facilitating the spread of disease, people living in elderly homes are at a higher risk of AG than elderly people living alone or with family members. [55-60]. Similar to the global trend, *Norovirus* is the predominant cause of AG outbreaks in elderly homes [61]. AG has been reported in many locations, including Rotterdam [18], Victoria [16], Switzerland [62], Maryland [47], Osaka [19] and Vienna [20]. Other pathogens, such as *Escherichia Coli* O 157:H7 [63], *Rotavirus* [64], and *Salmonella enteritidis* [65] have also been reported as the caused of AG in elderly homes.

Vectors

Unlike outbreaks in restaurants, hotels and households, in which the AG transmission route came from food-borne or waterborne transmissions [22, 66-68], the transmission of AG in elderly homes, is through person-to-person transmission [69]. The suspected first cases of the AG outbreaks might have resulted from contact with an asymptomatic individual [70, 71], such as a visitor [20], or staff of the elderly home [72]. In a review of 87 AG outbreaks in elderly homes in the Netherlands, in 2002, person-to-person transmission accounted for over 95% of the causes of the outbreak, with a few (2.3%) caused by a mixture of transmission routes (both food-borne and person-to-person transmission) and 2.3% were due to food alone [69]. In some cases, sharing staff among several elderly homes resulted in cross-home infections by person-to-person transmission [72].

Attack Rate

The attack rate was relatively high in most of the published elderly home AG outbreaks[15, 48]. It was as high as 65% in the chain outbreak among six elderly homes in the Tel-Aviv district of Israel [72] The attack rate of different locations of an elderly home may vary. It was found that in a *Norovirus* outbreak in a Dutch elderly home, the mean attack rate in four-bed rooms (69%) was higher than the one in single room (54%) [18]. Another *Norovirus* outbreak in Osaka, Japan revealed that the floor with a higher proportion of senile dementia residents had a higher attack rate [19]. The case-fatality rate was also higher in elderly home outbreaks than in the community

outbreaks. The case-fatality rate in community outbreak was between 0 to 2% while it was as high as 35% in elderly home outbreaks [73].

2.1.6 Mortality and disease burden

In a population survey on AG in the United States, AG accounted for approximately 195 million episodes, 41 million persons consulted a physician, 6.6 million provided a stool sample, 3.6 million hospitalization in each year and ten thousand related death annually [35, 74]. In Australia, the total number of AG cases was about 1.5 million annually. And the total number of visits to the general practitioner was about one million at a total cost of A$27 million. The average cost of prescribed medication per visit was A$6.83; and the estimated total cost of prescribed medication was about $A343 million [75]. In the Netherlands, the costs for gastroenteritis were 77 Euros per case, the total cost was 345 Euros million with the indirect cost, 284 Euros million annually. The AG associated loss was 67,000 DALYs (Disability Adjusted Life Years) approximately [76], while in England, it was estimated that 20% of the population experienced AG each year, with 9.4 million cases. The most common aetiologic agents were *Norovirus*, *Campylobacter* species, *Rotavirus* and non-typhoidal *Salmonella* species [44]. In addition to the direct medical costs, indirect costs also comprise a large proportion of disease burden.

Economic disease burden includes direct cost and indirect cost. Direct cost includes human illness costs such as medical costs, physician visits, laboratory costs, hospitalization fee, medication and ambulance costs. Indirect cost includes income or

productivity loss for ill person or cargiver, and other illness costs such as travel costs, institutional cares cost and loss of leisure time. Indirect costs for society include the costs of running the regulatory and public health sector, including disease surveillance costs such as monitoring pathogen incidence in the food chain outbreak; research costs such as identifying new food-borne pathogens and developing cheaper and faster pathogen tests; and outbreak cost such as cost for laboratory testing and the cost of cleanup [77].

The elderly suffer the most from AG in terms of hospitalization and mortality [78-82]. In a one year study of outbreaks of gastroenteritis in the Netherlands, 57% of the AG outbreaks were in elderly homes, followed by restaurants (11%), hospitals (9%), and day-care-centres (7%) [69]. In several studies of disease burden from *Escherichia Coli* O157:H7 in Alberta and other parts of Canada, the rates of hospitalization in the elderly (aged 60 and above) were twice as high as those of children under 5, and most deaths occurred in elderly who were from elderly homes [83]. In a review of AG disease burden in US adults from 1979 to 1995 [84], the hospitalization rates increased from 1.9/1,000 in the youngest adult group (20-49 years) to 7.6/1,000 in the oldest group (75 years or above). With about 74 thousand deaths over a 17-year period, an average of 4,300 patients with AG died annually. The fatality rate was 9.6 deaths/1,000 persons hospitalized with AG. A majority of these deaths occurred in the oldest age group, whose hospital-fatality rate (24.9/1,000) was eight times higher than those younger adults (20-49 years) (2.9/1,000). The oldest age group (188 deaths per one million per year) was 33 times

more likely to die than the younger adults (5.7 deaths per one million per year) in the population-based death rates. The mean length of stay also increased with age, from 4.1 days in the young adult to 7.4 days in the oldest [84].

2.2Factors associated with acute gastroenteritis

2.2.1 Personal hygienic risk factors

Hand hygiene

Hands can carry pathogens from faeces to surfaces, to foods, and to future hosts, and hand-washing with soap is effective in removing pathogens [85-87]. Hand-washing for 20 seconds with soap and with rubbing action is recommended for decontaminating hands to reduce cross-infection risks in hospital and after using the toilet [88]. For hands that have handled contaminated objects, one minute's hand-washing is recommended for disinfection, especially for the *norovirus*. A systematic review investigated 17 studies on the impact of washing hands with soap on the risk of diarrhoeal diseases [89]. The pooled relative risk of diarrhoeal disease associated with not washing hands was 1.74 (95%CI: 1.39-2.18), giving a reduction in risk of 43% (28-54%) for hand-washing. While the adjusted relative risk for not washing hands with soap and water was 1.78 (95%CI: 1.41-2.26), and the reduction in risk was 44% for hand-washing with soap and water.

In a review by Curtis, 'no hand washing' was found to be a significant risk factor for diarrhoea in 12 studies. In some extreme case, the relative risk was as high as 29.8 (95%CI: 2.19-407) in a case-control study in Indonesia, 1997 [90] where the risk factor was 'never use soap when washing hands'. Hand-washing practice before meals and after defecation was investigated by four studies [91-94]. 'No hand-washing before meal' was found to be significantly related to AG in two studies, 4.76 (95%CI: 1.05-25) (St Louis ME *et al.* 1990) and 1.73 (95%CI:1.15-2.20) [94]; while

'no hand-washing after defecation' was found to be a significant risk factor, RR:1.63 (95%CI:1.02-2.60) in a Brazilian study of urban child care centres [94].

Other personal hygiene

In addition to hand hygiene, other personal hygiene practices have been studied in relation to AG. The quality of water used in personal cleaning has been associated with AG. Bad or moderate water quality used for taking a bath, OR:6.5 (95%CI:1.47-28.8), and brushing teeth, OR:4.33 (95%CI: 1.25-15.2) increased the risk for AG [95]. Events indirectly related to hygiene practice, such as 'travelled outside the home', RR:1.3(95%CI:0.5-3.1); 'went to a market', RR:0.7 (95%CI: 0.3-1.5) and 'physical contact with someone with AG', RR:3.0 (95%CI:0.8-17.2) have been studied [93] but the results were not conclusive.

2.2.2 Institutional hygienic risk factors

Surface contamination

Contaminated fomites in the environment have been suggested as a possible source of infection [13, 96-98]. In an AG outbreak reported in Philadelphia, Pennsylvania in 2003, the initial case was suspected to be introduced by community though employees. However, the persistence of the outbreak was most likely caused by surface contamination. The results of pathogen testing on environmental surfaces within the elderly home indicated contamination in areas like the toilet seat and hand rail, dining room table, elevator button and bed rail. In their study, the environmental samples were collected 2 weeks after the outbreak peak, indicating the possibility that the spread were more extensive during the outbreak. Furthermore, at the time of collection, the elderly home had already undergone institution-wide cleaning. Contamination can persist for long periods despite routine decontamination efforts, due to either viral resistance or recontamination from prolonged shedding, and the contamination can spread to the whole elderly home through the isolation room and the elevator button [21].

In another study focusing on the shedding period, the causative pathogen was detected in the stool samples of the infected people for up to 13 days after infection [99]. Other studies have also demonstrated that *Norovirus* on experimentally contaminated surfaces can be readily transferred to other fomites via hands and washcloths [23]. Prolonged shedding, along with resistant factors, such as dementia,

incontinence, and immobility, may contribute to the extensive environmental contamination [21].

Method of disinfection

The aim of disinfection is to prevent transmission of the virus from contaminated surfaces via hands, cloths and other surfaces to the clean hands of an uninfected person, causing infection, either by direct transfer from hand to mouth, or transfer by handling of ready-to-eat foods. Several studies on the effect of disinfectants on cleaning and disinfection found that detergent-based cleaning with a cloth to produce a visibly clean surface was insufficient to eliminate virus contamination [23, 100, 100, 101]. Rinsing the cloth after the initial wipe, and then whiping the surface again was not effective in eliminating viruses. Experiments showed that when the rinsed cloth was used to clean the contaminated objects, and then used to wipe another surface, viruses could be spread to this secondary surface and to the bare hands of the person handling the cloth. This is because those non-enveloped viruses cannot be inactivated by lipophilic agents, such as detergent and alcohol [102]. As a result, the detergent-based cleaning without adequate disinfection increases the risk of infection rather than reducing the virus transmission [23].

The effectiveness of the disinfection depends on several factors. It was found that hypochlorite bleach at 5,000 ppm, which is the concentration used in many household surface cleaners, on faecal soiling was not totally effective [100, 103]. In Cogan's study, 28% of the surfaces were still contaminated with pathogens after

cleaning with hypochlorite bleach at 5,000ppm [100, 103]. There was little effect for increasing the contact time from 1 to 5 minutes. For the best disinfection, it was necessary to wipe the surface using a cloth soaked in detergent before applying the disinfectant. This is consistent with infection control recommendations for dealing with AG [104]. The guidelines state that contaminated solid matter should directly removed into a clinical waste bag, followed by cleaning of the contaminated area with detergent and hot water using a disposable cloth and then by disinfection with hypochlorite. However, it was found that if the faecal suspension from the contaminated surface was diluted to 1 in 10 and 1 in 80, treatment with a combined bleach and detergent at 5 ,000 ppm chlorine, without prior cleaning, was sufficient to decontaminate surfaces. This suggests that for secondary contact surfaces, disinfection with bleach is satisfactory. In addition, for cleaning soiled surfaces after gastroenteritis incidents, the use of disposable latex gloves is recommended [23].

Direct and indirect contact of fomites

It was found that contaminated fingers could transfer viruses for up to seven clean surface touches sequentially [23]. Similar studies also suggested that door handles and hands were efficient vectors for virus transmission [105]. At least 14 persons could be contaminated in succession by touching a contaminated door handle [106]. Epidemiological evidence suggests that environmental spread from an infected person occurs by settling of aerosol particles onto contact surfaces, which are then touched by the hands, or by splashing or aerosol generation during toilet

flushing, which spreads the virus to contact surfaces such as the toilet seat or flush handle [14, 107-109].

Infection control measures

Routine cleaning practice is important for AG prevention, while infection control measures are essential to control the spread of disease when a confirmed case is identified. In a routine surveillance on AG in North Staffordshire, UK, the environmental investigation in every outbreak included sanitary conditions, such as facilities for food storage and preparation, the hand-washing facilities, safe handling and disposal of clinical waste, disinfection standards and clinical practices to reduce the risk of cross infection [110]. Food preparation standards were generally good. However, a potential for cross contamination was observed when the same preparatory surface was used for handling raw and cooked foods in the main kitchen. The infection control audits identified poor facilities for hand washing for st aff, their rotation from clean to dirty jobs, and the practice of hanging clean and used uniforms side by side as significant lapses in infection control measures [71].

Lists of hygienic precautions have been suggested and implemented during AG outbreaks from the PHLS Advisory Committee on Gastrointestinal Infections [111]. The Committee summarized that individual precautions should include enforcement of hand hygiene: disinfection using an alcohol-based hand sanitizer for non-enveloped viruses, especially after hand contamination such as contact with a patient's intact skin or with environmental surfaces in the vicinity of the patient;

avoid shared towels, wearing of gloves and apron and surgical masks for contact with patients or contaminated environmental surfaces. Institutional precautions include daily environmental disinfection of surfaces in close proximity to the patients and more frequent routine cleaning and disinfection of ward bathrooms and toilets. Some policies can be implemented during AG outbreaks to improve the hygienic standard. These include written regimens for frequent cleaning of toilets; exclusion of affected staff from the ward for a symptom-free period of 48 hours; exclusion of non-essential personnel from the ward, avoidance of transfer of patients to unaffected wards or departments, minimization of movement of staff between affected and unaffected wards, discouraging agency staff from working in other health or social care centres, closure of new resident admissions, cancellation of social events, and terminal cleaning before re-opening rooms to returning residents [111].

All these practices aim to disinfect the contaminated areas and to prevent the spread of pathogens through person-to-person transmission. The time taken to enforce the infection control measures is also critical for pathogen spread. In an elderly home *Norovirus* outbreak in Rotterdam, disinfection control measures were not applied not until two weeks after the outbreak, during which time the virus spread throughout the home. Cases began to decrease after the implementation of the infection control measures [18]. It is suggested that while preventing the introduction of the pathogen into elderly homes was difficult, intervention especially in restricting staff and resident movement, clustering of infected cases

[112], and reinforcing personal hygiene of staff after close contact with infected residents, was effective in preventing extensive spread at the start of AG outbreak [113].

2.2.3 Factors causing inferior hygienic practice

Shared living environment

The setting, living conditions and the behavioural patterns of elderly homes also increase the risks of AG among the residents [81]. The residents are clustered in a confined living environment and encouraged to participate in group activities. Their meals and water come from a common source and they breathe the same air and share the medical care; infection of one resident may cause an outbreak in the elderly home due to these crowded living conditions and communal dining that encourage the person-to-person transmission.

This is evidenced by an outbreak case in Rotterdam in the Netherlands. Among the residents who shared rooms, 33% became infected one or two days after a roommate had been infected. The relative risk of co-infection within a room was 5.02(95%CI: 3.0-8.4). Also, resident-staff interaction potentates the AG transmission. Results showed that close contact with an infected resident (OR: 3.9; 95%CI: 1.3-11.4) was a significant risk factor for AG infection for staff, whereas other duties like preparing the food (OR:1.2;95%CI: 0.7-2.3) and room cleaning (OR:1.03; 95%CI: 0.5-2.0) that did not involve intimate contact did not show a significant risk. Staff to resident infection might enlarge the outbreak if the infected staff member continues to work or his/her infection is asymptomatic [18]. Transmission

of the virus by asymptomatic people is possible [70, 114, 115]. In a severe situation, cross homes infection has resulted. A large-scale outbreak affecting 146 residents and 33 staff members in six nursing homes in the Tel-Aviv district of Israel lasted for 3 weeks in 2002. The cross home infection resulted from social interaction between staff members and residents of these elderly homes, which were located in the same area [72].

Staffing

Caregivers are often inadequately trained in basic nursing techniques and may have little experience with the fundamental knowledge of infection control. High ratios of non-professional to professional staff and high rates of employee turnover make it difficult to establish and maintain an effective infection control system. Understaffing is also common in elderly homes, especially during the night hours. For the health status of staffing, most elderly homes have no formal guidelines for monitoring at the start of or during employment. Some have no formal polices that allow absenteeism for employees with infectious diseases. All these factors contribute to the spread of AG in elderly homes [81]. In Hong Kong, the main caregivers are the Health Worker (HW) or Personal Care Worker (PCW). A qualified HW has to complete a training course recognized by The Social Welfare Department. A course generally comprises 160 hours of lectures, 40 hours placement and one site visit. A PCW is a general helper with no formal training.

2.2.4 Risk factors other than hygienic factors

Consumption of risky food groups

Consumption of oysters [116], other shellfish[117], and raw eggs [118] has been the cause of AG in several outbreaks. However, the elderly rarely consume these food groups, especially those living in elderly homes, as their meals are prepared collectively. On the other hand, consumption of spoiled food is an obvious risk factor as enteric pathogens proliferate massively in certain situations [119]. For example, staff of the elderly home and CGAT nurse during the pilot study reported that it is a common practice that residents in elderly homes put their food from visitors on top of the cupboard next to their beds without proper storage. A collective history of poverty and want in this generation of Chinese woman has given rise to a 'no waste' mentality. They may therefore consume spoiled food products, either consciously or unconsciously.

Eating habits and nutritional status

Malnutrition, at any age leads to increased incidence of infections [120]. As nutrition is closely related to immunity, malnutrition can adversely affect a number of immune functions. For example, altered senses of smell and taste in the elderly may weaken the ability to recognize spoiled food while reduced fluid intake and subsequent dehydration due to the decline of thirst sensation in the elderly can also reduce immune function [121, 122]. This situation exacerbated in elderly homes. Residents in the elderly homes may have decreased nutrient intake becaus e of loss of control over food choices, inappropriate food temperatures or meal timing s, the need

for assistance with eating, unattractive eating surroundings, and the presence of noisy or disturbing residents during eating [122].

Medical history and age-related factors

Major surgery can result in a decrease in certain T-cell mediated immune functions, causing a short period of immunosuppression. Elderly persons who have age-induced immunosupression will be at additional risk for infections after major surgery, as compared with younger age groups [123]. Concerning long term medication, the frequent use of antibiotics alters the normal protective gastrointestinal flora, increasing the rate of infection and colonization by enteric pathogens [124]. As a result, antibiotic treatment may increase the risk of AG.

For the age-related factors, the decline in the digestive action in the elderly allows food pathogens to remain in the gut longer, increasing toxin production and damage. The acidity in the stomach environment plays an important role in limiting the number of bacteria that enter the small intestine. Thus, a decrease in stomach acidity in the elderly increases the chance of infection if a pathogen is ingested with food or water [125, 126]. Natural gastric juice is lethal to *Shigella sonnei* in vitro but there is no lethality when the pH of the juice is more than 3 [127]. Volunteer studies indicated that the infecting dose for *Vibrio cholerae* is about 10^8. However, neutralization of stomach acid by bicarbonate lowered the dose to about 10^4 [128].

In addition to changes in stomach acidity, gastrointestinal motility (peristalsis) decreases with age [129]. Peristalsis provides a mechanical means for

removal of ingested pathogens, with the strong peristalsis initiated by diarrhoea designed to eliminate the pathogens during infections. As a result, the decrease in intestinal peristalsis in the elderly increases their susceptibility to gastrointestinal infections [130].

Dementia also increases the risk of AG in terms of poor personal hygiene. Dementia may casuse immobility and inability to adequately express needs. This increases the risk of AG infection. For example, the elderly in care homes are highly dependent on their caregivers for their personal and environmental hygienic conditions. In cases of advanced dementia, where they are not able to communicate effectively regarding their illness, this may lead to delay in the notice of AG. Also, the hygienic conditions for elderly residents with dementia will be negatively affected when the staff to resident ratio is low, leading to delays in meeting their hygiene needs in a timely manner. As the dementia rate in the residents of elderly homes is proportionally higher than that of elderly living in the general community, there is a higher risk of them becoming infected than those in the community elderly population [131]. In an outbreak study in Osaka Japan, 2004, the attack rate in the floor where residents with senile dementia were housed was the highest (46%) compared with other floors ranging from 2% to 40% [19].

In summary, residents in elderly homes are at greater risk of AG infection because of several factors, including the decline of their personal hygienic condition as a consequence of their deteriorating levels of mobility. As a result, they are highly dependent on the staff of the elderly homes for their hygiene conditions. Secondly,

as the residents live in the enclosed institution, the institutional hygienic condition is an important factor. This group living environment may increase the possibility of person-to-person transmission. Lastly, other risk factors such as the decline in immunity, changes in food consumption, medication and surgery that apply to elderly people in general are also valid for the residents in elderly homes.

CHAPTER 3
MATERIALS and METHODS

3.1 Sampling method

Study population

From Dec 2007 to May 2009, case subjects were recruited from residents living in elderly homes in New Territories East district in Hong Kong, China. Inclusion criteria were Chinese residents living in the NTE elderly homes who experienced AG during the study period, with no age and sex restriction, while AG was defined as three or more loose stools or any vomiting in any 24h period. An AG outbreak is defined as the occurrence of . 2 cases, with some common factors, with dates of onset within 7 days of each other in the same elderly home [69, 132], while an outbreak home is defined as having at least one outbreak during the data collection period. Residents were excluded if their AG were due to non-infectious causes identified from the CGAT or nurses in the elderly homes based on a medical history including long term illness or medication leading to vomiting or diarrhoea. A total of 140 eligible cases were identified and interviewed, yielding a participation rate of 100%.

Control subjects were residents with no history of AG in the two months prior to recruitment and living in the same elderly homes during the same time period as the case subjects. They were individually matched by age (5-year interval) and sex to the case subjects and selected from the residential list in the elderly homes. According to the list order, the first two residents fulfilling the criteria were chosen

from the list. Residents would be considered as a case-matched control only once throughout the study. A wider age range was adopted if no control fulfilled the 5yr age range requirement. A case resident could be eligible to be a control once he or she had recovered and was symptom free for two months. If the selected control refused to participate in the interview, the next qualified case would be selected according to the list order. If the selected control was physically or mentally unfit for the interview, the interview would be carried out by proxy respondent (staff of the elderly home) after obtaining consent from the potential respondent's guardian. An incentive of $100 was given to the home and $50 was given to each case resident and control per every case reported.

The sample size calculation was based on the hypothesis of the protective effect of hand wash practice with soap against AG. The odds ratio of subjects exposed to the risk factor was shown to be 1.78 in a systemic review conducted by Curtis [89]. The probability of exposure among sampled control patients is 0.47(9/19), calculated from this pilot study. In a matched case-control study, with case to control ratio 1:2, . =0.05 and 1. . = 0.8, A sample of 145 case subjects and 290 control subjects were obtained by Matched Case-Control Power Analysis, NCSS (PASS) software 2006 (USA). The target population comprised residents in the elderly homes associated with the New Territory East cluster hospitals in Hong Kong. There were 113 elderly homes and 10,861 residents in 2007 [133].

3.1.1 Subject recruitment

All the elderly homes in the New Territories East were invited. Solicitation of participation was sought with the assistance of NTE cluster Community Geriatric Assessment Teams (CGATs). The NTE CGATs are groups of doctors and nurses from Sha Tin Hospital, Alice Ho Miu Ling Nethersole Hospital and North District Hospital. They visit the elderly homes 2-5 times on average to provide medical support to non-urgent cases. Invitation letters, pamphlets and posters were distributed to each elderly home either by hand or by mails. The survey details were explained in person or over the telephone and all the target elderly homes were contacted. A total of 2,995 residents from 34 homes were recruited in the study sample with a response rate of 30% (34/113).

3.1.2 Case notification

There were four channels for case notification: i) The participating homes were requested to report to the research team by phone or fax for any cases who fulfilled the case definition. ii) The research team contacted the homes twice per month for identification of AG cases. iii) Weekly phone contact with the NTE CGATs. iv) Through case referrals from Accident and Emergency Department, Prince of Wales Hospital for subjects belonging to the sampled elderly homes. The data collection period was from Dec 07 to May 09.

Every case notification was checked by the research team with the GGATs or the ICOs of the elderly homes to ensure that case definition of AG was met. Those

residents with an obvious non-infectious cause such as cancer of the bowel, irritable bowel syndrome, Crohn's disease, ulcerative colitis, cystic fibrosis, coeliac disease, any chronic illness with symptoms of diarrhoea and vomiting, or symptoms due to drugs and chemotherapy were excluded. If no non-infectious causes could be identified, those cases were recruited into the study. All the face-to-face interviewers were prearranged before home visits. The interview would be arranged for later or done by staff proxy if the infected resident was not physically fit for the interview. Institutional and observational data were collected twice, at the beginning of the study (from Feb-Apr 08) and at the end of the study (Feb-May 09) based on the same questionnaire and with the same observer.

3.1.3 Ethics approval

All staff representatives of the participating homes received verbal and written explanation. Informed consent was signed by the staff representative at the beginning of the study. Consent forms were signed by every participating case and control resident. If the residents were not able to answer the questionnaire, the questionnaire was answered by the staff of the elderly home with the approval of the residents' guardians. Eligible residents had the right to refuse or withdraw from the interview anytime if they felt uncomfortable. All identifying data were kept confidential. Ethical approval was obtained from the ethics committee at the Chinese University of Hong Kong in August 2007.

3.2 Data collection

Data collections were obtained through interviews and observations. Face-to-face interview based on structured questionnaires: i) interview of cases/controls to collect information on socio-economic characteristics, personal hygienic conditions, dietary intake, living habits, medical history, activities of daily living. Information on symptoms, medical consultation and treatment, and social and economic impacts of illness were also collected for the case residents during case reports. ii) interview of home staff to obtain institutional information on care and hygienic practices, ventilation facilities and food handling practices in Feb-Apr 08 and Feb-May 09. Institutional information about ventilation, environmental hygiene, and isolation room were also collected by observation from the research team during these two time periods. The incidence of AG was calculated by the total number of AG cases in the 34 recruited homes divided by the summation of total number of residents in the 34 recruited homes. The monthly total resident numbers in each elderly home was estimated by the information collected at the begining and the end of the study. Resident numbers in the first nine months were calculated using the data collected at the beginning of the study and resident numbers in the second nine months were calculated using the data collected at the end of the study.

3.2.1 Questionnaires

Institutional information

Basic information

Basic information of the elderly home included demographic data, staffing information and infection control measures. Demographic data included type of home, district, fees, number of floors, number of residents, resident capacity, number of rooms for residents, and number of washrooms. Staffing information included the number of supervisors, infection control officers (ICOs), registered health workers, personal care workers, registered nurses (RN), chefs and residing staff. Staff and residents' medical records on fever, diarrhoea and vomiting, and administrative procedures of sick leave were also recorded.

Infection control measures

Information on infection control measures included the number and qualifications of the Infection Control Officers, any AG outbreak within a month, and notification procedures during AG outbreak. For each case report, the site of stool or vomit excretion, and the exposure time of the contaminants in the environment were recorded.

Daily life practice

Daily life practice, including bedroom hygienic practice, hand-washing practice and information on the isolation room was recorded. Questions on routine cleaning practice included frequency of bed sheet and duvet cover changing, how stool or vomit contaminated bed sheets, duvet covers, clothes, floor and furniture

were handled and what types of personal protective equipment were used during such cleaning. Questions on sharing of toilet, sink, hand-dryer, bathroom, dining room, eating utensils and common areas were also asked. For hand-washing practice, questions on knowledge of hand-washing protocols for residents, staff hand-washing practices, type of disinfectant used, and glove changing practice were recorded. For the isolation room, information on number and type of isolation room, number of beds in isolation room, criteria for isolation room usage and return to own room policy, the presence of isolation room facilities such as toilet, sink, hand wash liquid, hand dryer, window, ventilation fan and air conditioner.

Environmental hygienic practice

Environmental hygienic practice was measured based on the cleaning frequency and disinfectant used for toilet, kitchen, floor, furniture, door handle, light switch and rubbish bin. Information on cleaning of the portable commode and type of personal protective equipment provided in the elderly home for staff and residents was also collected.

Ventilation facilities

Questions on the ventilation system focused on the availability, type and location of the air conditioning system. In addition to the air conditioning system, information on air fresheners, fans and extractor fans was also collected. Any complaints from residents about ventilation over the last preceding year were also recorded.

Food handling practice

Chefs were interviewed to provide information on food handling practice. This included their hand-washing practice, type of disinfectant used, duration of hand-washing, hand rubbing practice, towel sharing practice, use of apron, hat and mask during cooking, whether they work when suffering AG symptoms, and attendance at food hygiene health talks. For kitchen behaviours, questions on wound handling on hand injuries, storage methods for uncooked food, usage of dedicated chopping boards and knives for raw and cooked foods and defrosting methods were investigated.

Information of residents

Socio-economic characteristics

Socio-economic data were collected on age, years living in Hong Kong, marital status, educational level, religion, job history, year of retirement and income source. Age was determined by the birth date shown in Hong Kong identity card.

Hygienic conditions

Personal hygienic information included hand wash practice after using the toilet and before meals, use of hand wash detergent and duration, hand rubbing practice and towel sharing practice. Bathing frequency and frequency of clothes changing were also recorded.

Activities of daily living

Simplified Barthel Index (SBI) was used as a measurement of activities of daily living. The Barthel index, initially constructed for the evaluation of patients with neuromuscular and musculoskeletal disorders, is recommended for the assessment of impairment, physical rehabilitation and need for assistance in geriatric patients [134]. The index spotlighted the use of walking aids and the ability to perform ten daily activities: the ability to perform bowel movements, to void urine, to perform face washing, to use the toilet, eating, dressing, showering, turning around, mobility and walking up and down the stairs. The highest score is 20, indicating a high level of independene, a score of 15 -19 represents mild to moderate functional limitation and a score of below 15 indicates severe limitation [135].

Dietary intake

The questionnaire elicited information on the past seven days' consumption of some high risk food groups among the residents. This included left-over foods, take-away food, eggs, oysters, and shellfish. Food frequency intake was obtained of daily foods included fruit, vegetables, milk and dairy products, red and white meat, fish, and eggs. Self-evaluated nutritional status was recorded. Body Mass Index (BMI) was calculated based on the residents' most recent height and weight records.

Life style measurements

Life style measurements included measurement of: physical activity, smoking habits and places visited by the residents. 'Physical activity' comprised frequency and duration of exercises as reported by residents. 'Smoking habits' focused on past and present smoking habits, number of cigarettes consumed and period elapsed since

giving up tobacco. Information on daily living incorporated hospitalization over the last interview month, out of home history within the week preceding the interview, contact with AG patients, visitors, food type, food storage, and consumption of foods brought in by visitors.

Medical history

Information on medical history covered a list of diagnosed medical conditions including heart disease, hypertension, bronchitis, asthma, tuberculosis, gastrointestinal inflammation, diabetes, arthritis, bone fracture, Alzheimer's, psychological disorders and cancer. Current use of medicines, including antibiotics treatment was also included. The drug history served as a basis to exclude residents with non-infectious causes of AG.

Disease burden and economic impact

Symptoms

Symptoms were recorded to document the degree of severity of AG and to ensure the case resident fulfilled the case definition requirements. Symptoms included the date of onset and the number of diarrhoea and vomiting episodes, and bloody diarrhea within 24 hours. Other related symptoms such as fever, abdominal pain, headache, nausea, extreme thirst, and fatigue were also recorded. Information on self-reported attribution of symptoms related to food borne infection or person-to-person transmission were collected.

Medical consultation and treatment

Information obtained on medical consultation included the type of medical consultation, number of visits from visitors, medical fees, drug fees, and the person paying the medication and consultation fees. Information on specimen submission, specimen result, receiving IV fluids or injections and drug consumption details were also collected.

Social and economic impacts of AG

Data on the time loss of recreational activities, manpower and time spent on accompanying doctor visits by staff and home visits from relative and all expenses other than direct medical costs were recorded.

Observational information

Observational information included tangible conditions on the ventilation system, environmental hygiene and the floor plan. Myself and a research assistant (two persons in total) served as obervers. Most of the observational data were objective, indicating the presence or absence of the facilities under investigation. A handbook was given to the observers with definitions of some abstract terms such as clean, smelly and stuffy. Detailed guidelines on the choice of description were strictly followed.

Ventilation conditions

Information on ventilation focused on the windows, fans, air conditioners, air fresheners and extractor fans. Records were made on the number of these facilities and the proportion under operation.

Environmental hygienic condition

Areas under assessment included the common room, washroom, kitchen, and the isolation room. In the common room and washroom, general environmental cleanliness, floor, furniture and garbage bins were evaluated. For example, to determine if the environment was smelly, to check if dirt was present on the floor and on the furniture and whether the garbage bin was full and covered by a lid. Additional information on the function of toilet handles, sinks and hand dryers, and the presence of hand-washing liquid, tissue paper and towels were recorded. As well as overall environmental and floor cleanliness, assessment of the kitchen environment also included the refrigerator conditions: temperature, smell, fullness, food wrap practice, different storage levels for cooked and raw foods, freezer for raw meat and two separate refrigerators for cooked and raw food were assessed. Inspection on the cleanliness of the working table, extractor fans, cleaning cloths and aprons were also carried out.

Isolation room condition

The hygienic condition of the isolation rooms was not checked. However, the rooms were checked to determine whether any healthy residents were occupying the rooms in breach of the regulations, the availability of room usage and whether any ill residents were occupying the rooms during the interview period.

3.3 Statistical analysis

3.3.1 Verification and data entry

All the questionnaires were screened for completeness and accuracy before data entry. Any missing, confusing and incorrect answers were clarified. As some case subjects were still ill during the interview, some data (e.g. laboratory result and medication information) were later retrieved from the staff over the telephone. Double punch data entry was adopted. Data entry was completed within two weeks of the interview. Data cleaning and consistency checks were carried out before data analysis.

3.3.2 Types of variables

The independent variables included age, personal hygienic practice (hand wash practice after using the toilet and before meals, hand wash duration, soap use practice, hand rub practice, bathing practice and clothes changing practice). These variables were classified as personal hygienic potential risk factors. Other independent variables included eating habits (high risk food groups consumption, balanced diet eating practice, self-nutritional status interpretation); living habits (exercise, smoking habits, hospitalization history, out home history, visitors) medical history (including a list of chronic illnesses) and medication (including present medication and long term medication, and history of antibiotic use). The outcome variable was the experience of AG during the study period.

3.3.3 Data analysis method

Continuous variables were reported as mean and standard deviation (SD), and categorical variables were reported as percentages. The demographic characteristics in case and control groups were tested for statistical significance by Chi square or simple Student's t test. Univariate conditional logistic regression models were applied to analyze individual level risk factors. To test the hypothsis of whether poor personal hygienic factors are associated with AG in Hong Kong elderly homes, adjustment for potential confounders or potential biological mediators was performed in the multivariate conditional logistic regression. Odds ratios and 95% confidence intervals were calculated for each proposed risk factor. Collinearity check was done by bivariate correlation among the predictor variables. Descriptive analysis was performed on the institutional characteristics in outbreak and non-outbreak homes. All analyses were carried out using the Windows-based SPSS statistical package (version 13.0, SPSS Inc. Chicago, IL), and P values less than 0.05 were considered to be significant. The relationship between individual hygienic factors and institutional factors was investigated by interaction analysis.

CHAPTER 4
RESULTS: DESCRIPTIVE STATISTICS

4.1 Sampling distribution

Table 4.1 shows the sampling distribution among the private and subvented elderly homes in the three New Territories East (NTE) districts in Hong Kong. Private homes are run independently while the subvented homes are under government subsidies. We recruited 34 elderly homes, comprising 2,995 residents in the NTE to be the survey sample at the beginning of the study. The residents who lived in the elderly homes were regarded as our subjects during the data collection period. As a result we obtained a dynamic list of subjects as residents moved in and out of the homes during the data collection period. One of the recruited elderly homes in North District was closed in January 2009. In addition to some fluctuation in the number of residents in each elderly home, 2,826 subjects were recorded at the end of the study, a slight drop of 5.6%. Eighteen homes in Sha Tin were recruited, 6 in Tai Po and 10 in North District, while none was recruited in Sai Kung. The sampling composition skewed to Sha Tin, representing about 50% of its population, while it accounted 15% of its population for Tai Po and 22% for North District. The majority samples (N=29) came from private homes while 5 were subvented homes. Table 4.2 shows the number of residents in each elderly home. Comparing the scale of the two types of recruited homes in term of resident number, subvented homes had a larger scale (N= 109 to 265) than private homes (N=21 to 210). The average incidence was 0.02-0.19 per 1,000 residents per day.

4.2 Sporadic and outbreak case report: definition and sample collection

A total of 140 cases were reported during the study period, which accounted for 97% of the required sample size (N=145). The slight drop in the sample collected changed the power (1- .) slightly from 0.8 to 0.79 which should be considered as insignificant. Fifty-nine percents (n=82) of the cases were reported during winter (from Dec to Feb) while the remaining cases were scattered in other seasons (Table 4.3; Fig. 4.1). The case reported date was considered as the date in which the infected resident demonstrated symptoms that fulfilled the inclusion criteria. We encountered approximately 20 exlcuded non-infectious cases such as diarrhoea due to food allergy, medication, and vomiting due to chemotherapy and transportation. If no non-infectious cause was identified, the case would be included in the study. Among the 34 participating homes, 59% (n=20) reported at least one case, the number of cases reported ranged from 1 to 38. The subvented homes reported more cases than the private homes, accounting for 60% (n=84) of case reports. This was either due to underreporting of the private homes or beacuse the actual incidence rate was lower in private homes. An AG outbreak was defined as the occurrence of . 2 cases, with some common factors (e.g. live in the same home), with dates of onset within 7 days of each other [69, 132]. Based on this definition, 24 outbreaks involving 83 residents and 57 sporadic cases were recorded among the 20 reported homes. Outbreaks were distributed in 8 elderly homes involving 2 to 8 residents. Most of the elderly homes encountered 1 to 4 outbreaks while one elderly home encountered 9 outbreaks throughout the study period. The attack rate ranged from 0.8-15.8% (median: 1.89%) (Table 4.4).

Among the 140 cases, 17 cases were cross-over from control to case or vice versa. The control selected might have AG infection at sometime during the study period, so they might be selected as control at the beginning of the study but they became cases when they got AG infection later in the study. On the other hand, cases were eligible to become control cases after being symptom free for 2 months. These cases and their corresponding controls were excluded and multivariate conditional logistic regression was run on these 123 cases. The results were compared with the findings from the full set (140 cases) to address the limitation.

4.3Face-to-face interviews

All the interviews were conducted in the elderly homes. Among the 140 cases, 37% (n=52) were conducted by the residents while 56% (n=78) were conducted by proxy respondents, i.e. by staff of the elderly homes (Table 4.5) mainly due to the physical or mental condition of the residents (Table 4.6).A few interviews (7%) were conducted by both the residents and the proxy respondents. All the proxy respondents were the staff of the elderly homes that provided day-to-day care to the case residents. A higher proportion (79%) of the interviews was done by residents themselves among the control group. This was because some of the case residents were physically ill from AG or were placed in isolation, and therefore not able to complete the questionnaires. The possible selection bias of more active and healthy control selected from the staff was avoided, as controls were selected according to the resident list. No significant difference was found on items 'Alzheimer's' and 'SBI' between the case and control groups.

4.4Demographic characteristics among case and control group

The case and control groups were comparable in all demographic characteristics. No significant difference was found among the two groups (Table 4.7-4.8). Among the 140 cases, 72% (n=101) were women while 28% (n=39) were men. The mean age of case group was 84.7 (SD: 7.7), which is slightly higher than the control group (83.9, SD: 7.3) but the difference was not statistically significant. The age range had a great variation from 57 to 101 in case group and from 60 to 102 in control group. The age range of 80-99 accounted for approximately 80% of residents recruited. Most residents had lived in Hong Kong for a long time. The mean year for the cases living in HK was 62.1, and 60.7 in the control group. The majority of the respondents were widows or widowers (68% in case; 70% in control).

More than half of the recruited residents had no formal education. Approximately 15% had received only elementary education, and approximately 25% had primary education. Over 80% were employed when they were young, and over 60% of these had worked in elementary occupations, or worked as skilled agricultural and fishery workers. Most of the residents (83% in case; 90% in control) had stopped working from 2 to 39 years. Economically, they relied heavily (>80%) on government or retirement pay while some residents received financial support from family (Table 4.8).

The subject homes recruited in this study were composed of approximately 3,000 residents in 34 elderly homes located in Sha Tin, Tai Po and North District.

The sampling distribution was skewed to Sha Tin and private homes; subvented homes were generally on larger scale than private homes. The number of case reports peaked in winter time and the numbers of case reports between the homes varied enormously from 1 to 38. During the data collection period, 24 outbreaks and 57 sporadic cases were identified. Subvented homes reported more cases than the private homes and the attack rates were relatively low. A larger percentage of the interviews were conducted by proxy respondents (staff of the elderly homes) in the case group than the control group due to physical or mental impairment. The case and control groups were comparable in all demographic characteristics. Over 70% of the subjects were women, with a mean age of 84.5, with approximately 80% of being in the age range of 80 to 99. Most of them had lived in Hong Kong for many years, had received no formal education, had worked in rudimentary and unskilled jobs, and were financial dependent on government or family.

Table 4.1 Sampling distribution among the private and subvented elderly homes in the three New Territories East (NTE) districts in Hong Kong

		Sha Tin	Tai Po	North District	Total
Population	Home total	35	34	46	115
	Private	22	26	37	85
	Subvented	13	8	9	30
	Resident total	3266	3721	3557	10544
	Private	1746	2291	2051	6088
	Subvented	1520	1430	1506	4456
Recruit	Home	18(51%)*	6(18%)*	10(22%)*	34(29.5%)*
	Private	15	5	9	39
	Subvented	3	1	1	5
	Resident	1626(50%)*	572(15%)*	797(22%)*	2995(28.4%)*
	Private	1048	432	632	2112
	Subvented	578	140	165	883

* The percentage indicates the sample proportion of sample among the population within the district

Population data source: Social Welfare Department, HKSAR[136]

Table 4.2 Number of residents in the recruited elderly homes

Code of elderly home	Number of residents (at the beginning of the study)	Number of residents (at the end of the study)
S1	204	200
S2	109	91
S3	26	18
S4	28	21
S5	38	38
S6	21	20
S7	265	266
S8	80	79
S9	32	27
S10	118	111
S11	26	26
S12	150	150
S13	33	29
S14	80	44
S15	134	130
S16	28	65
S17	210	211
S18	44	49
T1	61	53
T2	140	112
T3	38	36
T4	54	53
T5	119	119
T6	160	156
N1	21	24
N2	186	188
N3	51	50
N4	109	105
N5	165	154
N6	52	(Closed in Jan 2009)
N7	33	32
N8	118	105
N9	21	22
N10	41	42
Total	2995	2826

* 'S' represents Sha Tin, 'T' represents Tai Po, 'N' represents North District;

Bolded code indicates the subvented homes

Table 4.3 Number of case report(s) by months from Dec 07 to May 05

Month	Year	Case(s)	Month	Year	Case(s)	Month	Year	Case(s)
Dec	07	10	Jul	08	9	Feb	09	13
Jan	08	7	Aug	08	2	Mar	09	5
Feb	08	18	Sep	08	5	Apr	09	4
Mar	08	2	Oct	08	12	May	09	2
Apr	08	6	Nov	08	1			
May	08	8	Dec	08	16			
Jun	08	2	Jan	09	18			

Table 4.4 Distribution of case reports among the 20 reported homes

* Attack rate is calculated as: no. of case reports/total resident *100

Home code	Case report	Sporadic	Outbreak	Outbreak resident involved	Attack rate*
S2	19	9	4	2-3	1.8 – 4.4
S5	11	5	1	6	15.8
S7	12	4	2	2-6	0.8 – 2.3
S10	3	3	0	---	---
S12	1	1	0	---	---
S14	1	1	0	---	---
S15	1	1	0	---	---
S16	2	2	0	---	---
S28	1	1	0	---	---
T1	2	2	0	---	---
T2	15	2	4	2-6	1.4 –5.4
T3	1	1	0	---	---
T4	5	1	1	4	7.6
T5	17	4	2	5-8	4.2 – 6.7
T6	2	2	0	---	---
N2	3	3	0	---	---
N4	3	3	0	---	---
N5	38	11	9	2-6	1.2 – 3.6
N6	1	1	0	---	---
N8	2	0	1	2	1.7
Total	140	57	24	2-8	0.8-15.8

Table 4.5 Respondent characteristics among the 420 face-to-face interviews

Respondent characteristic	Case	%	Control	%	Total	%
Resident	52	37.1	222	79.3	274	65.2
Proxy respondent	78	55.7	50	17.9	128	30.5
Resident and proxy respondent	10	7.2	8	2.8	18	4.3
Total	140	100	280	100	420	100

Table 4.6 Reason for proxy interview

Reason for proxy	Case	Control
Mental problem	24	32
Health problem	57	22
Refuse to answer	2	3
Cannot speak well	1	0
Not in the elderly home	4	1
Total	88	58

Table 4.7 Comparison of demographic information on sex, age, years living in HK and marital status, between case and control group

	Case		Control		
Variable	**n**	**%**	**n**	**%**	**p-value**
Sex					
Male	39	27.9	77	27.5	**0.938**
Female	101	72.1	203	72.5	
Age, years					
Mean ± SD	84.7	7.7	83.9	7.3	**0.317**
Max / Min	101	57	102	60	
. 59	2	1.4	0	0.0	
60-69	3	2.1	9	3.2	
70-79	25	17.9	56	20.0	
80-89	70	50.0	154	55.0	
90-99	39	27.9	59	21.1	
100-104	1	0.7	2	0.7	
Years living in HK					
Mean ± SD	62.1	20.1	60.7	19.6	**0.580**
Max / Min	98	15	98	2	
. 9	0	0.0	6	2.6	
10-19	1	1.4	4	1.8	
20-29	4	5.6	8	3.5	
30-39	4	5.6	8	3.5	
40-49	8	11.3	17	7.5	
50-59	9	12.7	49	21.5	
60-69	17	23.9	60	26.3	
70-79	9	12.7	34	14.9	
80-89	14	19.7	31	13.6	
90-99	5	7.0	11	4.8	
Missing	69	---	52	---	
Marital status					
Single	10	7.4	32	11.5	**0.26**
Married	26	19.1	46	16.5	
Widow/ widower	95	69.9	196	70.5	
Divorced	5	3.7	4	1.4	
Missing	4	---	2	---	

Table 4.8 Comparison of demographic information on education, job history and type, years of retirement and income source between case and control group

	Case		Control		
Variable	**n**	**%**	**n**	**%**	**p-value**
Education					
No schooling	64	53.3	148	54.4	**0.681**
Kindergarten	18	15.0	44	16.2	
Primary	30	25.0	65	23.9	
Secondary or above	8	6.7	12	4.4	
Missing	20	---	8	---	
Job history					
Yes	104	88.1	226	87.6	**0.882**
No	14	11.9	32	12.4	
Missing	22	---	22	---	
Job type					
Managers and administrators, Professionals /associate professionals or clerks	8	9.1	15	6.9	**0.443**
Service workers and shop sales workers, craft and related workers, or plant and machine operators and assemblers	24	27.3	55	25.5	
Elementary occupations, or Skilled agricultural and fishery workers	56	63.6	146	67.6	
Missing	16	---	10	---	
Years since no job					
2-19	22	34.9	79	40.5	**0.236**
20-39	30	47.6	97	49.7	
40-59	8	12.7	14	7.2	
60-78	3	4.8	5	2.6	
Missing	41	---	31	---	
Income source					
Family or none	26	19.1	52	18.7	**0.920**
Retirement pay or government	110	80.9	226	81.3	
Missing	4	---	2	---	

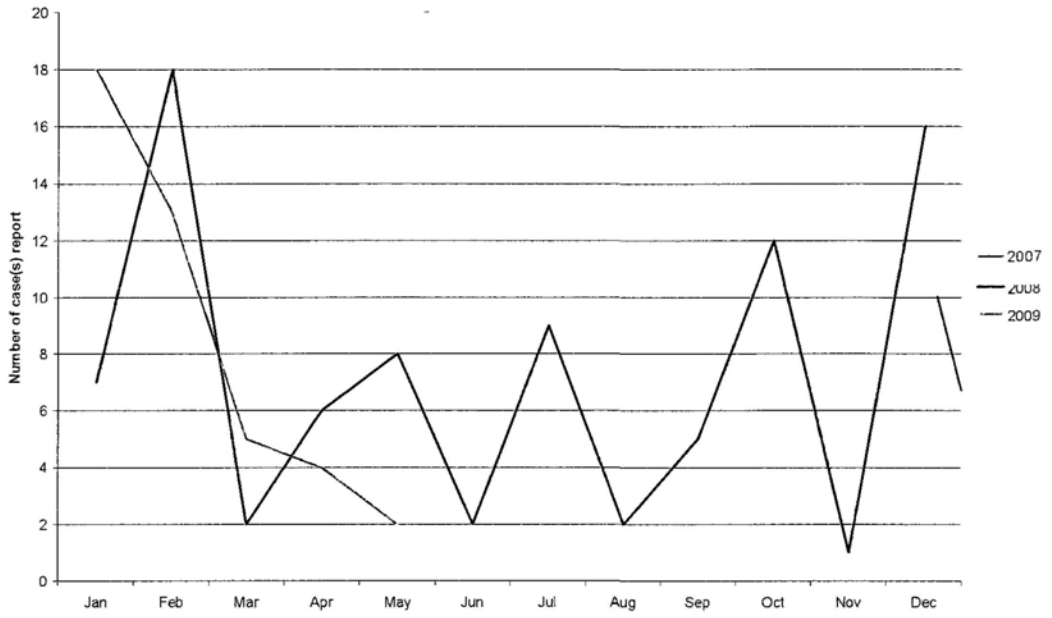

Fig. 4.1 Monthly case report(s) from Dec 07 to May 09

CHAPTER 5
INDIVIDUAL HYGIENIC RISK FACTORS

The main objective of this chapter is to describe the relation between the proposed personal hygienic risk factors with AG infection. Potential risk factors other than hygienic practice are also investigated.

5.1 Personal hygienic practice

Univariate conditional logistic regression analysis was performed to examine the associations of personal hygienic practice with the risk of AG. The hand wash practice of 'sometimes or never wash hands' after using the toilet was found to be a significant risk factor for AG (OR: 3.61; 95%CI: 1.65 – 7.88), compared with hand wash every time after using the toilet. The result was more apparent for 'never wash hand because using nappy' (OR:6.84;95%CI: 3.83 – 12.23). A similar trend was also found in the hand wash practice before meal, 'sometimes' (OR: 2.26; 95%CI: 1.23 – 4.14), 'never'(OR:2.68; 95%CI: 1.32 – 5.46), and 'use cloth to clean' (OR:10.19; 3.98 – 26.05) were found to be significant risk factors compared with hand wash every time before meal. 'Use cloth to clean' represented using dry cloth to clean hands without washing with water. For those with hand wash practice (N=109), it was unexpected that the practice of using 'wet tissue paper/alcoholic gel/sterilized cloth' scored an extremely high OR of 14.87 (95%CI: 4.34 – 50.88). No significant difference was found in the use of soap or not. In relation to hand wash duration, hand wash duration of '9 seconds or less' was found to be a significant risk factor (OR: 2.88; 95%CI: 1.14 – 5.85) compared with '10 seconds or more'. No significant

difference was found in hand rubbing, bathing and clothes changing practice (Table 5.1).

5.1.1 Other predictors of AG

Other than personal hygienic habits, other covariate factors, including eating habits, living practice and medical history were investigated with the risk of AG.

Eating habits and health status

Lists of eating habits and health status were found to have significant protective factors by univariate conditional logistic regression. They were: consumption of cooked shellfish (OR: 0.21;95%CI: 0.07 – 0.62) over the 7 days preceding the interview; self-nutrition evaluation as enough (OR: 0.49; 95%CI: 0.29 – 0.81); eating fruit (OR: 0.18 – 0.26; 95%CI: 0.06 – 0.78) vs no consumption; vegetable consumption 2-3 times a day (OR: 0.25; 95%CI: 0.13 – 0.50) vs consumption once per day or less; soy milk intake once per week (OR: 0.50; 95%CI: 0.29 – 0.87) vs no intake; white meat intake of once per day or more (OR: 0.13 – 0.93) vs no consumption; and fish (OR: 0.11 – 0.27; 95%CI: 0.03 – 0.79) vs no consumption. Significant risk factors were found for consumption of red meat (OR: 2.23;95%CI: 1.10 -4.53) vs no consumption. No significant difference was found among milk or milk products and cooked egg consumption toward AG. (Table 5.2 & Table 5.3).

Risk in AG pathogen exposure

Hospitalization, contact with AG patients, out home records and receiving visitors could increase the risk of AG infection by person-to-person transmission. In our study, 'hospitalization history within a month' before interview (OR:3.24; 95%CI: 1.84 – 5.71), and contact with AG patient (OR: 3.79; 1.72 – 8.36) were found to be significant risk factors against AG. 'Out of home history within the week' and 'being visited' had a risk association with AG, although the difference was not statistically significant. No significant differences were found among the behaviour of 'saving foods from visitor for later consumption' (Table 5.4).

Physical activity and smoking

'Exercise frequency of once per day or more' (OR:0.39; 95%CI: 0.22 – 0.71) was found to be a protective factor against those with '2-6 times per week or less'. However, no significant differences were found among physical activity, and past smoking habit (Table 5.5).

Medical history

Medical history data aimed to retrieve information on the association of chronic illness and the risk of AG. Stroke (OR: 2.32; 95%CI: 1.42 – 3.80), hypertension (OR: 1.61; 95%CI: 1.03 – 2.51), Alzheimer's (OR: 3.96; 95%CI: 2.23 – 7.05), cancer (OR: 4.00; 95%CI: 1.20 – 13.28), present medication (OR: 2.46; 95%CI 1.19 – 5.08) and antibiotic consumption history over the past few years (OR: 4.88; 95%CI: 1.28 – 18.6) were found be significant risk factors for AG by univariate conditional logistic regression. Other chronic illnesses listed were not

found to be associated with AG, including Parkinson's disease, heart disease, bronchitis, asthma, tuberculosis, GI inflammation, diabetes, arthritis, bone fracture, psychological disorder . Simplified Barthel Index was included in the questionnaire to assess whether the physical activity level would affect the risk of AG and the score was found to be a significant risk factor with OR: 5.87 (95%CI: 3.46 – 9.96) Individual indices in SBI that were relevant to AG, including bowel ability, ability to go to the washroom, eating ability and activity level were analyzed independently. Significant differences were found between case and control groups for all these individual indices (Table 5.6).

5.1.2 Risk estimates for other risk factors (adjusted for personal hygiene)

The independent effect of other risk facotors was estimated, adjusting for personal hygienic practice, as this was the most direct and theological risk factors for AG pathogen transmission. Hand wash practices before meals and after using the toilet were included in the adjustment. The result yielded 3 significant protective factors and 6 risk factors. The protective factors were 'self-nutrition evaluation as enough', Vegetable consumption of 2 to 3 times per day' (vs consumption of once per day or less), and 'exercise frequency of once per day or more' (vs 2-6 times per week or less). The 6 risk factors were 'hospitalization within a month', 'out of home history within a week', 'contact with AG patient within a week', 'heart disease', arthritis, and 'antibiotic consumption history' (Table 5.7 –Table 5.10). These factors were then input as covariates into the multiple logistic regression models.

5.1.3 Collinearity check for all predictor variables

To avoid collinearity, a total of 21 predictor variables were checked to identify the correlation among all predictor variables. The correlation of 60 pairs (28.6%) of predictors yielded significant results. The correlation was regarded as high and had to be handled cautiously if r >0.8 [137] Almost all the correlation coefficients (r) identified were not high in this study. The only pair of predictors that obtained r higher than 0.8 was 'bath taking practice' and 'clothes changing frequency' (Table 5.11). This was understandable as it is usual to change into clean clothes following a bath. As a result, the clothes changing practice was not included in the multiple logistic regression.

5.1.4 AG risk factor analysis

Multiple conditional logistic regression models were fitted to examine the independent associations of all potential risk factors on personal hygienic habits, eating and living habits, and medical history with AG. Twenty-one potential risk factors were identified and are listed in table 5.11. Besides 'clothing changing practice' (excluded due to collinearity), some predictor variables were also excluded, including 'detergent use', 'hand wash duration', 'saving foods for later consumption' and 'exercise frequency'. They were excluded because they were follow-up questions from some of the main questions, and many of the respondents did not answer these questions. BMI data were also excluded due to the high missing value rate of height data and the resultant inability to calculate the majority of BMI. Lastly, as 'age' is already adjusted during control selection, it is not included in the

regression model. As a result, 14 of the predictor variables were input into the multiple logistic regression models. Methods of enter (Table 5.1 2), forward stepwise conditional and backward stepwise conditional (Table 5.13) were performed. The final model was derived manually by removing the non-significant variables and retaining the significant variables (Table 5.14). Five significant risk factors for AG were concluded in the final model and the results of this final model served as the outline in the discussion session. They were: 'sometimes or never wash hands after using the toilet' (OR: 3.09; 95%CI: 1.28 – 7.42) vs hand wash after toilet every time; Self-nutrition evaluation as 'not enough' (OR: 2.07; 95%CI: 1.05 – 4.06); 'Having hospitalization in past month' (OR: 2.86; 95%CI: 1.16 – 7.05) , 'Simplified Barthel Index scored <15" (OR: 2.63; 1..06 – 6.53) and 'Alzheimer's' (OR: 2.75; 95% 1.18 – 6.40). Backward conditional logistic regression revealed the same four risk factors and some recorded higher odds ratios, which are 'sometimes or never wash hands after using the toilet' (OR: 5.02; 95%CI: 2.84 – 8.85); 'hospitalization in past month' (OR: 2.82; 95%CI: 1.40 – 5.70) ; 'Self-nutrition evaluation as enough' (OR: 2.26;95%CI: 1.26 – 4.06) and 'Alzhimer's' (OR: 2.08; 95%CI: 1.10 – 3.94). 'Away from institution during past week' (OR: 1.68; 95%CI: 0.97 – 2.91) and 'having antibiotic consumption history ' (OR: 8.95; 955CI: 0.94 – 85.37) recorded marginal significant results; while 'consumption of vegetables 2-3 times per day' recorded a significant protective factor (OR: 0.35; 95%CI: 0.16 – 0.78). Forward conditional logistic regression ran exactly the same results as backward conditional logistic regression (data not shown).

To reduce bias, the same multiple conditional logistic regression with manual adjustment was run with the amended two data sets. In the first data set, 17 cases which were cross-overs from case and control were excluded. The results yielded similar findings but the risk factors of 'Self-nutrition evaluation' and 'Simplified Barthel Index' shifted from significant risk factors to marginal significant risk factors (Table 5.15). In the second data set, 75 residents with Alzheimer's were excluded. The results also yielded similar findings of which 'sometimes or never wash hands after using the toilet' scored the highest significant risk factor. One more significant factors identified was 'having away from institution during past week' (OR:1.97; 95%CI: 1.04 -3.76) (Table 5.16).

Among the 140 case residents, 84 had a hand wash practice. This risk factor were further analyzed by multiple logistic regression with those significant covariates found in the previous regression by enter method with adjustment manually. No significant risk factors were identified. 'Do not use soap' (adjusted OR: 1.74; 95%CI: 0.7 – 4.33) and 'hand wash time . 9secs' (adjusted OR: 1.51; 95%CI: 0.57 – 3.98) were found to be a potential risk factors with AG. However, the results did not yield significant difference. No relationship was found between hand rub practice and AG (Table 5.17).

Primitive analysis by univariate conditional logistic regression was used to identify initial potential risk factors. Personal hygienic risk factors were retained in the multiple conditional logistic regression as they were the risk factors under

investigation in the main hypothesis. Potential risk factors other than personal hygienic practice included eating habits and health status, risk of AG pathogen exposure, physical activity and smoking, and medical history. Other significant potential risk factors, adjusted for personal hygienic factors, were identified, resulting in 21 potential risk factors. A further risk factor deduction by collinearity check and data quality summarized 14 predictor variables. The enter method with manual adjustment model was used in the final model. The model revealed 5 significant risk factors for AG infection. They were 'sometimes or never wash hands after using the toilet', 'self-nutrition evaluation as 'not enough'', 'having hospitalization in past month', 'SBI scored <15', and 'Alzheimer's'. The predictor variables of 'away from institution during past week', 'contact with AG patients during past week', and 'heart disease' also yielded a risk of AG infection although the results were not statistically significant.

Table 5.1 Univariate conditional logistic regression on personal hygienic practice among the case and control groups

	N		OR	95% of CI
	Case	Control		
Hand wash practice				
After toilet				
Every time	63	223	1	
Sometimes or never	16	17	**3.61****	1.65 - 7.88
Never because using nappy	61	40	**6.84****	3.83 - 12.23
Before meal				
Every time	50	179	1	
Sometimes	26	45	**2.26****	1.23 - 4.14
Never	22	30	**2.68****	1.32 - 5.46
Use cloth to clean	29	18	**10.19****	3.98 - 26.05
Detergent usage				
Use soap	53	182	1	
No	30	64	1.62	0.95 - 2.78
Duration				
10 sec or above	16	87	1	
9 sec or less	68	159	**2.88****	1.14 - 5.85
Hand rubbing				
Yes	82	238	1	
Sometimes or never	2	8	0.78	0.14 - 4.36
Bathing frequency				
Once per day or more	93	192	1	
Once every other day or less	47	88	1.27	0.65 - 2.47
Clothes changing				
Once per day or more	96	182	1	
Once every other day or less	44	98	0.70	0.36 - 1.34

OR, odds ratio; CI, confidence interval.
$^{**}p<0.01$; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values
or the items were follow up questions which were not applicable to all residents

Table 5.2 Univariate conditional logistic regression on eating habits over the previous 7 days and health status among the case and control groups

	N		OR	95% of CI
	Case	Control		
Eating habits (past 7 days)				
takeaway food				
Yes	10	16	1.25	0.57 - 2.75
No	130	264	1	
Egg(cooked)				
Yes	96	214	0.63	0.38 - 1.03
No	44	66	1	
Oyster (cooked)				
Yes	4	263	0.36	0.10 - 1.32
No	136	17	1	
Shellfish (cooked)				
Yes	5	35	**0.21****	0.07 - 0.62
No	135	245	1	
Self-nutritional evaluation				
Enough	88	193	**0.49****	0.29 - 0.81
Not enough	38	42	1	
BMI				
<18.5	10	18	1.37	0.56 - 3.32
. 18.5	27	71	1	

OR, odds ratio; CI, confidence interval.
**$p<0.01$; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values

Table 5.3 Univariate conditional logistic regression on eating practice among the case and control groups

	N		OR	95% of CI
	Case	Control		
Usual eating habits				
Fruit				
2-3 times a day	16	42	**0.18****	0 06 - 0 60
Once per day	88	181	**0.26****	0 10 - 0 71
Less than 1 per day	22	47	**0.26***	0 09 - 0 78
Never	14	10	1	
Vegetable				
2-3 times a day	114	263	**0.25****	0 13 - 0 50
Once per day or less	26	17	1	
Milk or milk products				
Once per day or more	66	121	1 12	0 69 - 1 81
2-6 times per week or less	18	46	0 77	0 40 - 1 51
Never	56	113	1	
Soymilk or soymilk products				
2-6 times per week or more	45	79	0 91	0 51 - 1 61
Once per week	41	114	**0.50***	0 29 - 0 87
2-3 times per month or less	14	28	0 73	0 33 - 1 63
Never	40	59	1	
Red meat				
2-6 times per week or more	20	20	**2.23***	1 10 - 4 53
Once per week or less	27	71	0 71	0 41 - 1 23
Never	93	189	1	
White meat				
Once per day or more	39	89	**0.35***	0 13 - 0 93
2-6 times per week	78	153	0 44	0 18 - 1 07
Once per week or less	9	25	0 33	0 10 -1 02
Never	14	13	1	
Fish				
Once per day or more	38	91	**0.17****	0 05 - 0 56
2-6 times per week	83	155	**0.27***	0 09 -0 79
Once per week or less	6	26	**0.11****	0 03 - 0 44
Never	13	8	1	
Egg (cooked)				
2-6 times per week or more	49	79	0 9	0 41 - 1 96
Once per week	66	163	0 51	0 25 - 1 06
2-3 times per month or less	8	15	0 69	0 24 -2 00
Never	17	23	1	

OR, odds ratio, CI, confidence interval

*p<0 05, **p<0 01, Figures in bold denote statistical significance

Table 5.4 Univariate conditional logistic regression on risk of AG pathogen exposure among the case and control groups

	N		OR	95% of CI
	Case	Control		
Hospitalization within a month				
Yes	37	29	**3.24****	1.84 - 5.71
No	103	251	1	
Away from institution during past week of interview				
Yes	74	141	1.12	0.73 - 1.70
No	66	139	1	
Contact with AG patients during past week				
Yes	26	24	**3.79****	1.72 - 8.36
No	114	256	1	
Being visited				
Yes	97	183	1.22	0.77 - 1.92
No	43	97	1	
Saving foods from visitor for later consumption				
Yes	45	114	0.58	0.33 - 1.02
No	49	69	1	
Day of left over food consumption				
Mean / SD	1.8 / 1.5	2.0 / 1.3	1.00	1.00 - 1.00

OR, odds ratio; CI, confidence interval.
**$p<0.01$; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values
or the items were follow up questions which were not applicable to all residents

Table 5.5 Univariate conditional logistic regression on the risk of AG pathogen exposure among the case and control groups

	N		OR	95% of CI
	Case	Control		
Physical exercise				
Yes	104	223	0.73	0.43 - 1.23
No	35	57	1	
Exercise frequency				
Once per day or more	68	179	**0.39****	0.22 - 0.71
2-6 times per week or less	36	44	1	
Exercise duration				
30 mins or more	40	95	0.79	0.46 - 1.34
29 mins or less	63	128	1	
Past smoking habit				
Yes	27	69	1.43	0.71 - 2.89
No	66	189	1	
Years since stopped smoke				
Mean / SD	16.0 / 11.6	21.6 / 16.0	1.02	0.93 - 1.12
Years of smoking				
Mean / SD	32.0 / 17.9	29.8 / 20.9	1.02	0.96 - 1.08
Average number of cigarettes				
Mean / SD	14.5 / 7.6	13.6 / 9.5	1.01	0.87 - 1.16

OR, odds ratio; CI, confidence interval.
**$p<0.01$; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values
or the items were follow up questions which were not applicable to all residents

Table 5.6 Univariate conditional logistic regression on medical history among the case and control groups

		N		OR	95% of CI
		Case	Control		
	Medical history				
a.	**Stroke**				
	Yes	46	51	**2.32****	1.42 - 3.80
	No	93	229	1	
	Don't know	1	0		
b.	**Parkinson's**				
	Yes	7	10	1.4	0.53 - 3.68
	No	132	268	1	
	Don't know	1	2		
c.	**Heart disease**				
	Yes	24	39	1.29	0.73 - 2.26
	No	116	241	1	
d.	**Hypertension**				
	Yes	98	168	**1.61***	1.03 - 2.51
	No	41	112	1	
		1	0		
e.	**Bronchitis**				
	Yes	9	12	1.57	0.63 - 3.94
	No	130	267	1	
		1	1		
f.	**Asthma**				
	Yes	6	13	0.92	0.34 - 2.48
	No	134	267	1	
g.	**Tuberculosis**				
	Yes	6	4	3.00	0.85 - 10.63
	No	134	276	1	
h.	**GI inflammation**				
	Yes	3	8	0.75	0.20 - 2.83
	No	137	272	1	

OR, odds ratio; CI, confidence interval.
*p<0.05;**p<0.01; Figures in bold denote statistical significance

Table 5.6 (continued) Univariate conditional logistic regression on medical history among the case and control groups

		N		OR	95% of CI
		Case	Control		
	Medical history				
i.	**Diabetes**				
	Yes	27	64	0.80	0.48 - 1.34
	No	113	216	1	
j.	**Arthritis**				
	Yes	17	33	1.07	0.57 - 2.03
	No	122	245	1	
k.	**Bone fracture**				
	Yes	18	34	1.07	0.58 - 1.96
	No	122	246	1	
l.	**Alzheimer's**				
	Yes	43	32	**3.96****	2.23 - 7.05
	No	97	248	1	
m.	**Psychological disorder**				
	Yes	13	15	1.77	0.81 - 3.87
	No	127	264	1	
n.	**Cancer**				
	Yes	8	4	**4.00***	1.20 - 13.28
	No	132	276	1	
	Present medication				
	Yes	128	233	**2.46***	1.19 - 5.08
	No	11	47	1	
	Antibiotic consumption history				
	Yes	8	4	**4.88***	1.28 - 18.6
	No	132	275	1	
	Simplified Barthel Index (SBI)				
	Score <15	52	80	**5.87****	3.46 - 9.96
	Score . 15	88	200	1	
	Individual index within SBI				
	- Bowel ability				
	Incontinence	76	61	**5.86****	3.40 – 10.09
	Self-controlled	64	219	1	
	- Washroom				
	Need Assistance	72	53	**6.75****	3.81 – 11.97
	Independence	68	227	1	
	- Eating ability				
	Need Assistance	28	24	**2.86****	1.53 – 5.36
	Independence	112	256	1	
	- Activity				
	Difficult or need assistance	89	88	**4.79****	2.91 – 7.90
	Independence	51	192	1	

OR, odds ratio; CI, confidence interval.
*p<0.05; **p<0.01; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values

Table 5.7 Conditional logistic regression on eating practice among the case and control groups adjusted for personal hygienic practice

	N		OR	95% of CI
	Case	Control		
Eating habits (past 7 days)				
Delivery food				
Yes	10	16	1.99	0.72 - 5.50
No	130	264	1	
Egg (cooked)				
Yes	96	214	0.86	0.43 - 1.71
No	44	66	1	
Oyster (cooked)				
Yes	4	263	0.71	0.17 - 3.03
No	136	17	1	
Shellfish (cooked)				
Yes	5	35	0.33	0.10 - 1.02
No	135	245	1	
Self-nutrition evaluation				
Not enough	38	42	**2.52***	1.18 - 5.40
Enough	88	193	1	
Don't know	14	45		
BMI				
<18.5	10	18	0.64	0.13 - 3.12
. 18.5	27	71	1	

OR, odds ratio; CI, confidence interval.
*p<0.05; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values

Table 5.8 Conditional logistic regression on eating practice among the case and control groups adjusted for personal hygienic practice

	N		OR	95% of CI
	Case	Control		
Usual eating habits				
Fruit				
2-3 times a day	16	42	1.12	0.14 - 8.90
Once per day	88	181	0.98	0.14 - 6.99
Less than 1 per day	22	47	1.14	0.15 - 8.64
Never	14	10	1	
Vegetable				
2-3 times a day	114	263	**0.28***	0.09 - 0.86
Once per day or less	26	17	1	
Milk or milk products				
Once per day or more	66	121	0.86	0.44 - 1.65
2-6 times per week or less	18	46	1.13	0.47 - 2.74
Never	56	113	1	
Soymilk or soymilk products				
2-6 times per week or more	45	79	0.78	0.31 - 1.97
Once per week	41	114	0.47	0.19 - 1.18
2-3 times per month or less	14	28	0.85	0.28 - 2.61
Never	40	59	1	
Red meat				
2-6 times per week or more	20	20	1.78	0.66 - 4.84
Once per week or less	27	71	1.39	0.62 - 3.11
Never	93	189	1	
White meat				
Once per day or more	39	89	2.83	0.29 - 28.05
2-6 times per week	78	153	2.76	0.31 - 24.65
Once per week or less	9	25	2.40	0.23 - 24.54
Never	14	13	1	
Fish				
Once per day or more	38	91	1.09	0.09 - 12.68
2-6 times per week	83	155	1.33	0.13 - 13.99
Once per week or less	6	26	0.85	0.055 - 12.92
Never	13	8	1	
Egg (cooked)				
2-6 times per week or more	49	79	2.48	0.64 - 9.52
Once per week	66	163	1.44	0.41 - 5.10
2-3 times per month or less	8	15	2.49	0.43 - 14.33
Never	17	23	1	

OR, odds ratio; CI, confidence interval.
*p<0.05; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values

Table 5.9 Conditional logistic regression on the risk of AG pathogen exposure among the case and control groups adjusted for personal hygienic practice

	N		OR	95% of CI
	Case	Control		
Living habit				
Hospitalization within a month				
Yes	37	29	**3.60****	1.54 - 8.43
No	103	251	1	
Out of home history within a week				
Yes	74	141	**2.69****	1.35 - 5.34
No	66	139	1	
Contact with AG patients within a week				
Yes	26	24	**15.10****	3.15 - 72.21
No	114	256	1	
Visitor				
Yes	97	183	1.16	0.61 - 2.23
No	43	97	1	
Saving foods for later consumption				
Yes	45	114	0.59	0.25 - 1.37
No	49	69	1	
Day of leftover over food consumption				
Mean / SD	1.8 / 1.5	2.0 / 1.3	0.20	0.02 - 19.17
Physical exercise				
Yes	104	223	1.48	0.62 - 3.53
No	35	57	1	
Don't know	1			
Exercise frequency				
Once per day or more	68	179	**0.30***	0.11 - 0.80
2-6 times per week or less	36	44	1	
Exercise duration				
30 mins or more	40	95	1.41	0.65 - 3.09
29 mins or less	63	128	1	
Past smoking habit				
Yes	27	69	2.54	0.93 - 6.93
No	66	189	1	
Years since given up on smoke				
Mean / SD	16.0 / 11.6	21.6 / 16.0	0.96	0.70 - 1.33
Years of smoking				
Mean / SD	32.0 / 17.9	29.8 / 20.9	2.55	0.47 - 13.78
Average number of cigarettes				
Mean / SD	14.5 / 7.6	13.6 / 9.5	0.89	0.68 - 1.15

OR, odds ratio; CI, confidence interval.
*$p<0.05$;**$p<0.01$; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing value
or the items were follow up questions which were not applicable to all residents

Table 5.10 Conditional logistic regression on medical history among the case and control groups adjusted for personal hygienic practice

		N		OR	95% of CI
		Case	Control		
	Medical history				
a.	**Stroke**				
	Yes	46	51	1.35	0.64 - 2.88
	No	93	229	1	
b.	**Parkinson's**				
	Yes	7	10	1.01	0.25 - 4.17
	No	132	268	1	
c.	**Heart disease**				
	Yes	24	39	**2.32***	1.05 - 5.16
	No	116	241	1	
d.	**Hypertension**				
	Yes	98	168	1.62	0.83 - 3.15
	No	41	112	1	
e.	**Bronchitis**				
	Yes	9	12	1.11	0.28 - 4.45
	No	130	267	1	
f.	**Asthma**				
	Yes	6	13	1.72	0.37 - 8.08
	No	134	267	1	
g.	**Tuberculosis**				
	Yes	6	4	0.54	0.07 - 4.15
	No	134	276	1	
h.	**GI inflammation**				
	Yes	3	8	1.72	0.14 - 21.87
	No	137	272	1	

OR, odds ratio; CI, confidence interval.

*$p<0.05$; Figures in bold denote statistical significance

N was not exactly the total sum in some items due to missing values

Table 5.10 (con'd) Conditional logistic regression on medical history among the case and control groups adjusted for personal hygienic practice

		N		OR	95% of CI
		Case	Control		
	Medical history				
i.	**Diabetes**				
	Yes	27	64	0.95	0.45 - 2.03
	No	113	216	1	
j.	**Arthritis**				
	Yes	17	33	**2.51***	1.02 -6.16
	No	122	245	1	
k.	**Bone fracture**				
	Yes	18	34	0.99	0.37 - 2.63
	No	122	246	1	
l.	**Alzheimer's**				
	Yes	43	32	1.88	0.76 - 4.67
	No	97	248	1	
m.	**Psychological disorder**				
	Yes	13	15	1.93	0.53 - 6.96
	No	127	264	1	
	Don't know	0	1		
n.	**Cancer**				
	Yes	8	4	1.74	0.24 - 12.47
	No	132	276	1	
o.	**Present medication**				
	Yes	128	233	2.12	0.76 - 5.92
	No	11	47	1	
		1	0		
p.	**Antibiotic consumption history**				
	Yes	8	4	**12.96***	1.15 - 145.56
	No	132	275	1	
	Don't know	0	1		
q.	**Simplified Barthel Index**				
	Score . 15	88	200	2.06	0.93 - 4.61
	Score <15	52	80	1	

OR, odds ratio; CI, confidence interval.
*$p<0.05$; Figures in bold denote statistical significance
N was not exactly the total sum in some items due to missing values

Table 5.11 Collinearity check for all predictor variables

r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	1.00	0.15**	0.08	0.17**	0.03	-0.05	-0.06	0.14	0.08	0.17**	-0.03	0.14**	-0.02	-0.08	0.03	-0.03	0.02	-0.02	-0.03	0.05	0.11*
2		1.00	0.60**	0.31**	0.12*	0.08	0.04	0.16	-0.02	0.63**	0.04	0.37**	0.03	-0.25**	0.11*	0.03	-0.03	-0.18**	-0.20**	-0.09	-0.04
3			1.00	0.12*	0.16**	0.18**	0.10	0.10	0.02	0.48**	0.07	0.27**	0.07	-0.15**	0.11*	-0.02	-0.01	-0.22**	-0.19**	-0.02	-0.04
4				1.00	-0.19**	-0.08	-0.08	0.07	-0.01	0.16**	-0.05	0.32**	-0.03	-0.09	0.06	0.05	-0.01	0.02	-0.03	-0.04	-0.04
5					1.00	0.05	0.08	-0.04	0.05	0.20**	0.10	0.04	0.14**	-0.20**	-0.02	-0.05	-0.06	-0.02	-0.11	0.02	-0.11*
6						1.00	0.90**	0.09	0.03	0.10**	0.03	-0.04	0.03	-0.13**	0.01	0.09	0.07	-0.08	0.10	-0.06	-0.10
7							1.00	0.08	0.03	0.06	0.03	-0.06	0.05	-0.17**	-0.01	0.11*	0.06	-0.05	0.11*	-0.09	-0.09
8								1.00	0.08	0.22*	-0.05	0.20*	0.13	-0.21*	0.00	-0.07	0.14	-0.27**	-0.14	-0.04	0.00
9									1.00	0.11*	0.03	-0.02	0.03	-0.05	-0.03	0.02	0.07	-0.02	-0.03	0.06	0.12*
0										1.00	0.06	0.33**	0.13**	-0.28**	0.05	0.06	-0.07	-0.21**	-0.27**	-0.03	-0.02
1											1.00	0.03	0.16**	0.05	0.03	0.03	-0.13*	-0.18**	-0.05	0.13**	0.03
2												1.00	-0.01	-0.17**	0.12*	-0.01	-0.11	-0.10*	0.01	-0.11	-0.08
3													1.00	0.20**	0.02	0.06	-0.11	-0.09	-0.19**	0.00	-0.06
4														1.00	-0.08	0.06	-0.08	0.04	0.06	0.10*	0.10
5															1.00	-0.04	-0.02	-0.02	-0.06	0.03	-0.05
6																1.00	---	0.01	-0.11	-0.01	0.02
7																	1.00	0.16**	0.08	0.05	0.15*
8																		1.00	0.14*	0.06	0.03
9																			1.00	0.01	0.08
0																				1.00	0.05
1																					1.00

Pearson correlation coefficient

1	Age	8	BMI	15	Contact with AG patient during past week
2	Hand wash after using toilet	9	Self nutritional evaluation	16	Visitor
3	Hand wash before meal	10	Simplified Barthel Index	17	Saving foods for later consumption
4	Detergent use	11	Antibiotic consumption	18	Vegetable consumption
5	Hand wash duration	12	Alzheimer's	19	Exercise frequency
6	Bath taking practice	13	Hospitalization within a month	20	Heart disease
7	Clothes changing frequency	14	Out home history within a week	21	Arthritis

* Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

-- Not suitable for comparison as no valid answer for 17 if 16 = no

Table 5.12 Multiple conditional logistic regression on potential risk factors with all potenial risk factors

	N		Adjusted-OR	95% of CI
	Case	Control		
Hand wash practice after using toilet				
Every time	63	223	1	
Sometimes or never	77	57	**3.56***	1.68 - 7.54
Hand wash practice before meal				
Every time	50	179	1	
Sometimes or never	90	101	1.08	0.57 - 2.06
Bathing frequency				
Once per day or more	93	192	1	
Once every other day or less	47	88	1.01	0.58 - 1.78
Self-nutrition evaluation				
Enough	88	193	1	
Not enough	38	42	**2.10***	1.14 - 3.84
Simplified Barthel Index				
Score . 15	88	200	1	
Score <15	52	80	1.70	0.84 - 3.45
Antibiotic consumption history				
No	132	275	1	
Yes	8	4	6.52	0.61 - 69.88
Alzheimer's				
No	97	248	1	
Yes	43	32	*1.89*	0.97 - 3.68
Hospitalization in past month				
No	103	251	1	
Yes	37	29	**2.56***	1.23 - 5.33
Away from institution during past week				
No	66	139	1	
Yes	74	141	**1.87***	1.04 - 3.36
Contact with AG patients during past week				
No	114	256	1	
Yes	26	24	1.86	0.88 - 3.92
Visitor				
No	43	97	1	
Yes	97	183	0.93	0.53 - 1.63
Vegetables				
Once per day or less	114	263	1	
2-3 times a day	26	17	**0.37***	0.16 - 0.84
Heart disease				
No	116	241	1	
Yes	24	39	1.51	0.73 - 3.14
Arthritis				
Yes	17	33	1	
No	122	245	1.04	0.47 - 2.28

Adjusted-OR, adjusted-odds ratio; CI, confidence interval.
*$p<0.05$; Figures in bold denote statistical significance
Number in italic: marginal significance
Model selection method: Enter

Table 5.13 Stepwise multiple conditional logistic regression on potential risk factors

	N		Adjusted-OR	95% of CI
	Case	Control		
Hand wash practice after toilet				
Every time	63	223	1	
Sometimes or never	77	57	**5.02****	2.84 – 8.85
Hospitalization in past month				
No	103	251	1	
Yes	37	29	**2.82****	1 40 – 5.70
Self-nutrition evaluation				
Enough	88	193	1	
Not enough	38	42	**2.26***	1.26 - 4.06
Antibiotic consumption history				
No	132	275	1	
Yes	8	4	8.95	0.94 – 85 37
Alzheimer's				
No	97	248	1	
Yes	43	32	**2.08***	1.10 - 3.94
Away from institution during past week				
No	66	139	1	
Yes	74	141	1.68	0.97 – 2.91
Vegetables				
Once per day or less	114	263	1	
2-3 times a day	26	17	**0.35***	0 16 – 0.78

*p<0 05, **p<0.01

Method used: Backward conditional
The following variables were not included in the forward conditional logistic regression model: Hand wash practice before meal (every time vs sometimes or never), Bathing frequency (Once per day or more vs once every other day or less), Out home history within a week (outof home vs not out of home), Contact with AG patients (Yes vs No),Visitor (Yes vs No), Vegetable consumption (2-3 per day vs . 1 per day), heart disease (Yes vs No), Arthritis (Yes vs No)
Adjusted-OR, adjusted-odds ratio; CI, confidence interval.
*p<0.05, **p<0 01; Figures in bold denote statistical significance
Model selection method: Backward conditional method
Probability for stepwise: p-entry: 0.05; p-removal: 0.1; maximum iterations: 20

Table 5.14 Multiple conditional logistic regression on potential risk factors with manual adjustment

	N		OR	95% of CI
	Case	Control		
Hand wash practice after toilet				
Every time	63	223	1	
Sometimes or never	77	57	**3.09***	1.28 - 7.42
Hand wash practice before meal				
Every time	50	179	1	
Sometimes or never	90	101	0.94	0.44 - 2.00
Self-nutrition evaluation				
Enough	88	193	1	
Not enough	38	42	**2.07***	1.05 - 4.06
Vegetables				
Once per day or less	114	263	1	
2-3 times a day	26	17	0.45	0.16 - 1.25
Hospitalization in past month				
No	103	251	1	
Yes	37	29	**2.86***	1.16 - 7.05
Away from institution during past week				
No	66	139	1	
Yes	74	141	1.52	0.78 - 2.96
Contact with AG patients during past week				
No	114	256	1	
Yes	26	24	1.49	0.52 - 4.28
Simplified Barthel Index				
Score . 15	88	200	1	
Score <15	52	80	**2.63***	1.06 - 6.53
Alzheimer's				
No	97	248	1	
Yes	43	32	**2.75***	1.18 - 6.40
Heart disease				
No	116	241	1	
Yes	24	39	1.69	0.73 - 3.95

*p<0.05

Adjusted-OR, adjusted-odds ratio; CI, confidence interval.

*p<0.05; Figures in bold denote statistical significance

Model selection method:enter with adjustment manually

Table 5.15 Multiple conditional logistic regression on potential risk factors with manual adjustment (with 17 cross-over cases and control cases excluded)

	N		OR	95% of CI
	Case (123)	Control (246)		
Hand wash practice after toilet				
Every time	57	201	1	
Sometimes or never	66	45	**3.56****	1.36 – 9.32
Hand wash practice before meal				
Every time	44	163	1	
Sometimes or never	79	83	1.24	0.55 – 2.83
Self-nutrition evaluation				
Enough	76	168	1	
Not enough	35	38	1.91	0.91 – 4.01
Vegetables				
Once per day or less	100	232	1	
2-3 times a day	23	14	0.50	0.17 – 1.45
Hospitalization in past month				
No	92	222	1	
Yes	31	24	**3.01***	1.08 – 8.42
Away from institution during past week				
No	57	122	1	
Yes	66	124	1.67	0.80 – 3.51
Contact with AG patients during past week				
No	99	225	1	
Yes	24	21	1.66	0.47 – 5.85
Simplified Barthel Index				
Score . 15	48	181	1	
Score <15	75	65	2.18	0.82 – 5.84
Alzheimer's				
No	86	223	1	
Yes	37	23	**4.01****	1.48 – 10.85
Heart disease				
No	103	210	1	
Yes	20	36	1.47	0.58 – 3.74

*p<0.05, ** p<0.01

Adjusted-OR, adjusted-odds ratio; CI, confidence interval.

*p<0.05; Figures in bold denote statistical significance

Model selection method: enter with adjustment manually

Table 5.16 Multiple logistic regression on potential risk factors with manual adjustment (with 75 residnents with Alzheimer's excluded)

	N		OR	95% of CI
	Case (97)	Control (248)		
Hand wash practice after toilet				
Every time	52	211	1	
Sometimes or never	45	37	**4.81****	2.04 – 11.37
Hand wash practice before meal				
Every time	43	167	1	
Sometimes or never	54	81	0.82	0 40 – 1.68
Self-nutrition evaluation				
Enough	59	167	1	
Not enough	27	39	**2.17***	1.12 – 4.22
Vegetables				
Once per day or less	80	234	1	
2-3 times a day	17	14	0 43	0.18 – 1.05
Hospitalization in past month				
No	69	221	1	
Yes	28	27	**2.38***	1.08 – 5.23
Away from institution during past week				
No	38	117	1	
Yes	59	131	**1.97***	1.04 – 3.76
Contact with AG patients during past week				
No	81	229	1	
Yes	16	19	2.10	0.87 – 5.05
Simplified Barthel Index				
Score 15	44	189	1	
Score <15	53	59	1 87	0.84 – 4.14
Heart disease				
No	77	210	1	
Yes	20	38	1.54	0 73 – 3 22

*p<0 05, **p<0.01
Adjusted-OR, adjusted-odds ratio; CI, confidence interval
*p<0.05; Figures in bold denote statistical significance
Model selection method:enter with adjustment manually

Table 5.17 Multiple conditional logistic regression on hand wash practice

	N		Adjusted-OR*	95% of CI
	Case	Control		
Detergent usage				
Use soap	53	182	1	
No	30	64	1.74	0 70 - 4 33
Duration				
10 sec oı above	16	87	1	
9 sec or less	68	159	1 51	0.57 - 3.98
Hand rubbing				
Yes	82	238	1	
Sometımes or nevei	2	8	0.10	0.01 - 1.17

*Adjusted for sıgnıficant covaıiate factors found ın multıple condıtıonal logıstıc regıession by enter method wıth adjustment manually. Hand wash practıce after toılet (every tıme vs sometımes oı never), Hospıtalızatıon wıthın a month (yes vs no), selfnutrıtıon evaluatıon (enough vs not enough), sımplıfıed barthel ındex (score. 15 or scoıe < 15) and Alzheımei's (yes vs no).
Adjusted-OR, adjusted-odds ratıo; CI, confidence ınteıval.

CHAPTER 6

Institutional characteristics among outbreak and non-outbreak homes

All residential care homes for the elderly (RCHEs) must be licensed to legitimize their operations under the Residential Care Homes (Elderly Persons) Ordinance (Cap.459A Sect 18): The Inspection of Residential Care Homes [138]. This involves the overall setting including the fire drill plans, set up of isolation room and the ventilation measures. The hygienic practice is monitored by the Guidelines on Prevention of Communicable Diseases in Residential Care Homes for the Elderly, governed by CHP, HKSAR [139]. This section describes the relationship between the institutional characteristics among the outbreak homes and non-outbreak homes. The institutional characteristics include the infection control practice and facilities, environmental hygienic practice, and food handling practice among outbreak and non-outbreak homes. A total of 8 elderly homes encountered AG outbreaks. The analysis was based on the first set of data collected in Feb-Apr 08, the second set of data collected (Feb-May 09) served to monitor the consistency of the home practice and environmental condition (Table 6.1).

6.1 The setting and basic characteristics

The outbreak homes (OHs) constituted 4 private and 4 subvented homes while the non-outbreak homes (NOHs) consisted of 25 private homes and 1 subvented home. OHs and NOHs were quite different in terms of the setting and basic characteristics. The maximum fee in NOH double that of OHs. Tai Po shared

the greatest OH proportion while Sha Tin shared the least. More than 80% of the homes consisted of 1 to 3 floors while two NOHs had 7 floors. The median number of residents was much higher in OHs (N=109) than the NOHs (N=46), while over 200 residents were recorded in both the largest OHs and NOHs. The median number of rooms was much higher in outbreak homes (30) than non-outbreak homes (7.5) but a maximum of 104 rooms was recorded in a non-outbreak home. Fixed room type constituted the highest proportion (50%) in OHs while more than half (54%) were with fixed room and partition type in NOHs. The median resident to toilet seat ratios were similar in OHs and NOHs, but the maximum ratio was much higher in NOHs than OHs (Table 6.2).

Both OHs and NOHs usually had one supervisor and one infection control officer (ICO). Approximately 50% of both the OHs and NOHs had 1-3 health workers. The health worker to resident ratio was much lower in OHs in general. The ratio for the majority (81%) of the NOHs was 1:20 -29 while over 30% of the OHs had a ratio of 1:40-55, and one even had no HW in the elderly home. Both OHs and NOHs shared similar PCW to resident ratios while most of the homes did not have an RN and the RN to resident ratio was very low in general. (Table 6.3 and Table 6.4).

6.2 Infection control records, practice and facilities

Records

The OHs and NOHs shared similar infection control characteristics. All elderly homes had health records for fever, diarrhoea and vomiting for their residents and most had also kept records for their staff. Concerning the sick leave policy, a higher percentage of OHs had to present sick leave certificates than NOHs. The Infection Control Officers were mostly health workers in NOHs while about one-third were registered nurses in OHs. The rest were enrolled nurses, or had taken an infection control course. One ICO in an outbreak home did not have any qualifications. Nearly all elderly homes did not have AG outbreak over the past month of the interviews except in one OH.

In case of an AG outbreak, most of the homes would inform the Centre for Health Protection (CHP) HKSAR, and their district CGAT team. Some would also notify the social welfare department-licensing branch and one outbreak home informed the Hospital Authority. It was common for the residents admitted and discharged between elderly homes and hospitals. CGAT teams visited the elderly homes on a regular basis. Usually the CGAT doctors visited the elderly homes less frequently than the CGAT nurses. CGAT nurses visited the elderly homes 5-6 times per week in both OHs and NOHs while there was one NOH that did not have a CGAT nurse visit (Table 6.5).

Facilities

In terms of infection control facilities, all elderly homes had at least one isolation room (IR). All IR were of fixed room type and usually had one bed. More OHs had the facilities of toilet, sink, hand-wash liquid or soap, hand dryer, window and air conditioner than NOHs. The exception was the ventilator in which NOHs had a higher installed percentage than OHs. There was one IR with no window and half of the NOHs did not have hand-wash liquid or soap. A similar proportion of the OHs and NOHs would send the AG residents to IR while some elderly homes would only send residents occasionally depending on severity. One NOH claimed they would not send their AG resident to IR while one OH claimed they would send the AG resident to hospital immediately without isolation (Table 6.6).

Practice

Most of the isolated AG residents were isolated from the non-AG residents in terms of toilet, bathroom, dining, and common area. However, a number of homes still needed to share toilet, bathroom and facilities such as sink due to the absence of such facilities in IRs. Some homes without such facilities claimed they would reserve a public toilet for the AG residents and that they would place the AG resident(s) at the end of the queue to take a bath, with complete sterilization of the bathing facilities afterwards. The data revealed one NOH shared the dining room and 2 OHs shared the common area among the AG and non-AG residents. Staff from all elderly homes claimed they taught the correct hand washing time and method to the residents regularly. In case of an AG outbreak, all outbreak homes would use 1:49

bleach to clean the faecal or vomit contaminated bed sheets, duvet cover, clothes, floor and furniture. However, 3 non-outbreak homes claimed they would use 1:99 bleach only. Most of the staff would wear masks, gloves and protective clothing when handling contaminated items, but still there were staff from one OH and 8 NOHs who did not wear masks during such cleaning. In addition, there were staff from one OH and 2 NOHs who did not wear gloves. Some staff members claimed they would wear apron, goggles, face shield, shoe protection and hat. The majority of homes used 3 to 4 protective measures, but still two homes (1 outbreak and 1 non-outbreak home) did not wear any protective clothing or equipment. On the other hand, all staff members would use soap to wash their hands and change gloves after handling the contaminants. These data were retrived by face-to-face interview. (Table 6.7).

6.3 Environment hygienic aspect

All elderly homes had air conditioning systems located in the bedrooms, public areas, offices and the isolation rooms. Usually the air conditioners were window type, but some were also of split or centralized types. Some elderly homes had a combination of the three types. There were no air fresheners in NOHs while 75% of the OHs had such facility located in the public areas, the isolation rooms and washrooms All elderly homes had fans, but a higher proportion of fans were found in the bedrooms and public areas in NOHs than in OHs. All homes had extractor fans, most of which were located in the washroom, while some were also found in the bedroom, public area, office and isolation room. Two complaints about ventilation

from staff or residents were recorded in both OHs and NOHs over the past year (Table 6.8).

Regarding the routine cleaning practice, most of the OHs and NOHs cleaned the bathrooms, kitchen, floors, furniture, door handles, light switches and waste bins daily by using 1:99 bleach. Some homes would also use Dettol® and Kit Chi Duck® for cleaning the bathrooms, and using a common agent called 'green water' for the floor (Table 6.10). A higher percentage of the NOHs would have a more frequent routine cleaning practice than the OHs. For example, 27% of the NOHs cleaned the bathrooms twice per day, comparing 13% in OHs. And the highest frequency was four times per day in one NOH. None of the OHs would clean the kitchen, floors, furniture, door handles and light switches more than once per day. However, over 20% of the NOHs would clean the kitchen 2 to 3 times per day, 40% would clean the floors 2 to 4 times per day and about 20% would clean the furniture, door handles and light switches 2-3 times per day in the NOHs (Table 6.9). Above 60% of the homes would clean the commodes toilet after every use, but more than 30% of the homes would clean them only once per day. All elderly homes had good storage of the protective equipment such as mask, gloves, face shield, goggles, shoe protection, hat and protective clothing. Only one OH did not have a face shield and one NOHs did not have the storage for shoe protection (Table 6.10).

6.4 Food handling practice

The chefs of the elderly homes were interviewed on food handling practices and knowledge. All chefs practiced hand washing before cooking and after using the toilet with the use of soap. Over 50% and 73% of the chefs in outbreak homes and non-outbreak homes washed their hands over 20 seconds, while one chef in a non-outbreak home claimed a hand washing practice of less than 5 seconds. All chefs had a hand rubbing practice and would not share towels during hand drying. During cooking, they all wore aprons, a higher percentage of the chefs in outbreak homes wore the chef hat and a mask (both 63%) than the chefs in non-outbreak homes (hat: 39%; mask: 42%). Almost all chefs replied they would not continue to work if they developed AG symptoms. However, there was one chef in the non-outbreak home said that he or she would continue to work with AG symptoms because there was no replacement worker available. All chefs in the outbreak homes attended health talks on food handling compared with 73% of the chefs in non-outbreak homes. Most of the chefs used medical sticking plasters to treat wounds in the finger while 3 chefs in the non-outbreak homes claimed they would wear gloves instead. In order to avoid cross contamination, they all had two sets of knifes and chopping boards for handling raw and cooked food. For defrosting the frozen food, most of the chefs put the frozen food in the lower compartment of the refrigerator or under the running water while three chefs in the non-outbreak homes allowed the frozen food to defrost at room temperature (Table 6.11).

6.5 Observational comparison

The observational data aimed to collect the on-site circumstances on ventilation and environmental hygiene in various parts of the elderly homes. The area under investigation included bedrooms, public area such as dinning rooms or entertainment areas, washrooms, kitchen and isolation rooms.

Bedrooms

Ventilation in the bedrooms was satisfactory in general. All bedrooms had window and fan except one non-outbreak home that did not have window and two non-outbreak homes that did not have fans. Over 70% of the windows were opened more than half way in 63% of the outbreak homes and 36% of the non-outbreak homes. Fans were activated to a lesser extent. Over 80% of the elderly homes switched on 30% of the fans. Three outbreak homes and 2 non-outbreak homes did not have an air-conditioning system, and none of the homes had air conditioner running during the interview period, from February to April 2008. Only about half of the elderly homes had extractor fans and these were activated more frequently in outbreak homes than non-outbreak homes. 75% of the non-outbreak homes had an activation rate from 0 to 30% while 67% of the outbreak homes had a 31% to 100% activated rate (Table 6.12).

Public areas

The public areas were generally in good hygienic condition. The overall environments were fresh and clean. The floors and furniture were clean overall. Only one non-outbreak home was reported to smell unpleasant and another non-outbreak

home was found to have dirt on the furniture. More waste bins were present in non-outbreak homes. More than half (54%) of the non-outbreak homes had waste bins in the public area, in contrast with only 25% in the outbreak homes. Nearly all waste bins were not full and with lid covered. Only one waste bin was found to be full and two were without lid in the non-outbreak homes (Table 6.13).

Washrooms

Items under investigation in the washrooms included the overall environment, floor, toilet seat, hand washing basin, soap, tissues, hand dryer, common and individual towel and waste bin. The overall environments in both outbreak and non - outbreak homes were clean and fresh smelling. The floors and the toilet seats were clean, and without contaminants on the toilet seats. The hand washing basins were clean and non-clogged, with hand-wash liquid or soap present. Most of the toilets did not have paper towels, hand dryer or communal towel for hand drying. Two elderly homes (1 outbreak home and 1 non-outbreak home) had individual towels located in the toilet, which were clean overall. Again, more non-outbreak homes (62%) had waste bins in the toilet than the outbreak homes (25%). Most of the waste bins were lidded and not full (Table 6.14).

Kitchens

The hygienic condition in most of the kitchens in the elderly homes was satisfactory. In most of the outbreak and non-outbreak homes, the overall environment was not smelly. The floors in the outbreak homes were cleaner (87.5%)

than the non-outbreak homes (54%) in general. Smelly refrigerators were recorded in 1 outbreak and 3 non-outbreak homes. All foods in the refrigerator were wrapped and stored with sufficient space for air circulation in all outbreak homes, while unwrapped food was observed in the refrigerators of two non-outbreak homes. In most of the homes, the cooked foods were placed in the upper part while the raw foods were put in the lower part of the refrigerator. Over 58% of the non-outbreak homes and 75% of the outbreak homes did not store cooked food in the refrigerator. Both outbreak and non-outbreak homes habitually discarded leftover foods. Two outbreak homes and 4 non-outbreak homes had separate refrigerators for cooked and raw food, but 2 non-outbreak homes did not have freezers for frozen meat. Refrigerator temperature ranged from between 0 to 4°C but some were recorded between 4 to 8°C and 2 were recorded to be above 8°C in the non-outbreak homes. Most of the work tables and extractor fans were clean. Higher percentages of dirty cloths and aprons were recorded in non-outbreak homes than in outbreak homes (Table 6.15).

Isolation rooms

All isolation rooms in both outbreak and non-outbreak homes were functional and were not occupied by non-ill residents. Some rooms were occupied by ill residents during the interview period (Table 6.16).

Eight OHs and twenty-six NOHs were identified. Descrpitve analysis was used to compare the OHs and NOHs. OHs and NOHs were quite different in terms of setting and basic characteristics. The OHs had a higher median number of residents and rooms, higher proportion of fixed room type , a lower resident to toilet seat ratio, and a lower health worker to resident ratio than the NOHs. In terms of infection control records, practice and facilities, a higher percentage of OHs required their staff to present sick leave certificates, employed more RNs as ICOs, and had better IR facilities than NOHs. On the other hand, OHs and NOHs practiced similar isolation policies, practice of CGAT teams visits, method and agent used for disinfection and the use of PPE during disinfection.

In terms of ventilation facilities, a higher proportion of OHs had air fresheners and had more fans in bedrooms and public areas than NOHs while both types of homes had air conditioning systems. Comparison on rountine cleaning practice showed that a higher percentage of the OHs had a less frequent routine cleaning practice in places and on objects such as bathrooms, kitchens, door handles, and light switches. Observational data revealed OHs had better ventilation in terms of the percentage of open windows and extractor fans in use, but had fewer waste bins in both common areas and toilets than the NOHs.

6.6 Relationship between individual factor and institutional factors

Interaction analyses were run between the individual hygienic factor and institutional factors. The dependent variable was the experience of AG during the study period. The individual hygienic factor under investigation was 'Hand wash practice after toilet', as it was the most significant individual hygienic risk factor in the multiple conditional logistic regression. Institutional factors that might be related to personal hand wash practice were included in the interaction analysis. They were 'Resident to toilet seat ratio', 'Staff to resident ratios of ICO, HW, PCW, and RN', 'Qualification of ICO', 'availability of hand wash liquid/soap in the washroom', and 'Frequency of bathroom cleaning practice'. No interaction was found among the investigated factors (Table 6.17).

Table 6.1 Quality check for the institutional and observational data among the two batches taken in 2008 and 2009

Questionnaire items	Match % among two punches of data*
Infection control practice	83
Ventilation facilities	94
Environmental hygienic practice	87
Food handling practice	85
Observational data	81

* The match % among two punches of data was calculation by: number of matched answer / Total number of choices in that specific questionnaire items

Table 6.2 Basic characteristics among the outbreak and non-outbreak homes

Characteristics	n Outbreak homes	%	n Non-outbreak homes	%
Number of homes	8	---	26	---
Fee				
Median	3300	---	5000	---
Minimum	1700	---	2000	---
Maximum	5750	---	12000	---
Home type				
Private	4	50.0	25	96.2
Subvented	4	50.0	1	3.8
Total	8	100.0	26	100.0
Home district				
Shatin	3	37.5	15	57.7
Taipo	3	37.5	3	11.5
North District	2	25.0	8	30.8
Number of floors				
1	1	12.5	9	34.6
2	4	50.0	6	23.1
3	2	25.0	7	26.9
4	1	12.5	1	3.8
5	0	0.0	1	3.8
7	0	0.0	2	7.7
No. of residents				
Median	109	---	46	---
Minimum	40	---	18	---
Maximum	265	---	205	---
Capacity				
Median	134.5	---	56.5	---
Minimum	41	---	21	---
Maximum	276	---	220	---
No. of Rooms				
Median	30	---	7.5	---
Minimum	0	---	0	---
Maximum	69	---	104	---
Room capacity				
Median	5	---	2	---
Minimum	2	---	1	---
Maximum	8	---	4	---
Room type				
Fixed room	4	50.0	5	19.2
Partition	1	12.5	7	26.9
Both fixed room and partition	3	37.5	14	53.8
Resident to toilet seat ratio				
Median	6.0	---	7.3	---
Minimum	2.0	---	2.5	---
Maximum	8.5	---	30.4	---

Table 6.3 Basic characteristics among the outbreak and non-outbreak homes: staff information

Characteristics	n Outbreak homes	%	n Non-outbreak homes	%
Staff				
Supervisor				
0	1	12.5	1	3.8
1	5	62.5	22	84.6
2	1	12.5	2	7.7
3	1	12.5	1	3.8
Infection Control Officer (ICO)				
1	4	50.0	20	76.9
2	4	50.0	5	19.2
4	0	---	1	3.8
Health worker (HW)				
0	1	12.5	1	3.8
1-3	4	50.0	15	57.7
4-6	3	37.5	6	23.1
7-9	0	---	3	11.5
16	0	---	1	3.8
Founder who is also a qualified health worker				
Yes	0	---	6	23.1
No	8	100.0	19	73.1
Personal Care Worker (PCW)				
3-10	3	37.5	19	73.1
11 -20	4	50.0	2	7.7
21 -30	0	---	3	11.5
31-40	0	---	0	---
41 -50	0	---	1	3.8
51 -60	1	12.5	1	3.8
Registered nurse (RN)				
0	4	50.0	19	73.1
1 - 2	3	37.5	4	15.4
3 - 4	0	---	1	3.8
5 - 6	1	12.5	2	7.7
Chef				
1	3	37.5	21	80.8
2-3	3	37.5	3	11.5
4-5	2	25.0	2	7.7

Table 6.4 Basic characteristics among the outbreak and non-outbreak homes: staff information: Staff to resident ratio

Characteristics	n Outbreak homes	%	n Non-outbreak homes	%
Staff to resident ratio				
Supervisor ratio				
18 - 49	1	12.5	14	53.8
50 - 99	3	37.5	5	19.2
100 - 199	3	37.5	6	23.1
No supervisor	1	12.5	1	3.8
ICO ratio				
16 - 49	2	25.0	16	61.5
50 - 99	2	25.0	4	15.4
100 - 199	4	50.0	5	19.2
200 - 205	0	---	1	3.8
HW ratio				
10 - 19	1	12.5	11	42.3
20 - 29	3	37.5	10	38.5
30 -39	0	0.0	1	3.8
40 - 55	3	37.5	3	11.5
No HW	1	12.5	1	3.8
PCW ratio				
4 - 9	6	75.0	22	84.6
10 - 19	2	25.0	3	11.5
20 - 29	0	---	1	3.8
RN ratio				
30 - 79	1	12.5	7	26.9
80 - 165	3	37.5	0	---
No RN	4	50.0	19	73.1
Chef ratio				
18 - 99	7	87.5	21	80.8
100 -199	1	12.5	4	15.4
200 -205	0	---	1	3.8

Table 6.5 Comparison on the infection control record and practice among the outbreak and non-outbreak homes

Infection control record and practice	n	%	n	%
	Outbreak homes		Non-outbreak homes	
Health record for				
Fever, Diarrhoea and Vomit				
Staff	6	75.0	22	84.6
Residents	8	100.0	26	100.0
Sick leave policy				
Need to present leave certificate	7	87.5	11	42.3
Need not present leave certificate	1	12.5	15	57.7
Resume work after sick leave				
Immediate	5	62.5	17	65.4
1-2	1	12.5	2	7.7
Until recovered	1	12.5	7	26.9
ICO Qualifications				
Took infection control course	1	12.5	0	---
Registered Nurse	3	37.5	7	26.9
Health worker	2	25.0	16	61.5
Enrolled nurse	1	12.5	0	---
No	1	12.5	3	11.5
AG outbreak over a month of interview				
Yes	1	12.5	0	---
Organization to be informed in case of AG outbreak				
CHP	6	75.0	20	76.9
CGAT	6	75.0	17	65.4
HA	1	12.5	0	---
Social welfare department-licensing branch	3	37.5	12	46.2
Resident released from hospital over a month of interview				
Yes	8	100.0	25	96.2
CGAT visit				
Doctor				
Once to twice per week	4	50	14	53.8
Every 2 to 3 week	0	---	4	15.4
Once per month	1	12.5	4	15.4
Every 5 to 6 week	2	25	0	---
No visit	1	12.5	4	15.4
Nurse				
5-6 times per week	4	50.0	11	42.3
2-4 times per week	2	25.0	7	26.9
Less than once per week	0		6	23.1
Once per month	2	25.0	1	3.8
No visit	0	---	1	3.8

Table 6.6 Comparison on the infection control facility among the outbreak and non-outbreak homes

Infection control facility	n Outbreak homes	%	n Non-outbreak homes	%
Presence of isolation room (IR)				
Yes	8	100.0	26	100.0
Number of isolation rooms (IR)				
1	7	87.5	24	92.3
2	0	0.0	1	3.8
3	1	12.5	0	---
4	0	---	1	3.8
Send to IR for AG resident				
Yes	4	50.0	12	46.2
Occasionally, depends on severity	3	37.5	13	50.0
No	1	12.5	0	---
Send to hospital immediately	0	---	1	3.8
Time to return to own room since isolation				
Until the resident is fully recovered	5	71.4	18	72.0
Until the condition is under control, not fully recovered	1	14.3	4	16.0
3 days	0	---	1	4.0
4 days	0	---	1	4.0
7 days	1	14.3	1	4.0
Type of IR				
Fixed room	8	100.0	26	100.0
Bed(s) in IR				
1	4	50.0	19	73.1
2	0	---	5	19.2
3	2	25.0	2	7.7
4	1	12.5	0	---
5	1	12.5	0	---
No. of beds in IR : 100 resident				
<1	2	25.0	1	3.8
1 -3	4	50.0	19	73.1
4 -7	2	25.0	6	23.1
Facility in IR				
Toilet	7	87.5	15	57.7
Sink	7	87.5	20	76.9
Handwash liquid / soap	7	87.5	14	53.8
Hand dryer	3	37.5	3	11.5
Window	8	100.0	25	96.2
Ventilator	7	87.5	24	92.3
Air conditioner	5	62.5	14	53.8

Table 6.7 Comparison of infection control practice in the outbreak and non-outbreak homes

Infection control practice	n	%	n	%
	Outbreak homes		Non-outbreak homes	
Share of the following among AG and non-AG residents				
Toilet	3	37.5	5	19.2
Sink	4	50.0	7	26.9
Hand dryer	0	---	3	11.5
Bathroom	4	50.0	9	34.6
Dining room	0	---	1	3.8
Common area	2	25.0	3	11.5
Teaching of hand-wash procedure by staff				
Yes	8	100.0	24	92.3
Teaching of when hand-wash is needed by staff				
Yes	8	100.0	24	92.3
Bed sheets replacement				
Once per week or more	6	75.0	22	84.6
Once every 1-2 weeks	1	12.5	2	7.7
Once every 2 weeks	1	12.5	2	7.7
Duvet cover replacement				
Once per month or more	6	75.0	22	84.6
Once every 1-2 months	0	---	3	11.5
Once every 2-4 months	2	25.0	1	3.8
Treating contaminated bed sheets				
1:99 bleach	0	---	3	11.5
1:49 bleach	8	100.0	23	88.5
Treating contaminated duvet cover				
1:99 bleach	0	---	3	11.5
1:49 bleach	8	100.0	23	88.5
Treating contaminated clothes				
1:99 bleach	0	---	3	11.5
1:49 bleach	8	100.0	23	88.5
Treating contaminated floors				
1:99 bleach	0	---	2	7.7
1:49 bleach	8	100.0	24	92.3
Treating contaminated furniture				
1:99 bleach	0	---	2	7.7
1:49 bleach	8	100.0	24	92.3

Table 6.7 (continued) Comparison on the infection control practice the outbreak and non-outbreak homes

Infection control practice	n Outbreak homes	%	n Non-outbreak homes	%
Wear the following when handling contaminated items				
Mask	7	87.5	18	69.2
Gloves	7	87.5	24	92.3
Apron	5	62.5	10	38.5
Protective clothing	8	100.0	20	76.9
Goggles	1	12.5	3	11.5
Face shield	2	25.0	1	3.8
Shoe protection	0	---	5	19.2
Hat	0	---	2	7.7
No. of protective measure worn				
0	1	12.5	1	3.8
2	0	---	6	23.1
3	2	25.0	8	30.8
4	3	37.5	10	38.5
5	1	12.5	0	---
6	1	12.5	1	3.8
Wash hands after handling contaminated items				
Yes	8	100.0	26	100.0
Use soap				
Yes	8	100.0	26	100.0
Change gloves				
Yes	8	100.0	26	100.0

Table 6.8 Comparison on environmental hygienic aspect (ventilation) among the outbreak and non-outbreak homes

Environmental hygienic aspect	n Outbreak homes	%	n Non-outbreak homes	%
Ventilation				
Air conditioning system				
Yes	8	100.0	25	96.2
Type of air conditioning system				
Bedroom				
1 Centralized type	0	---	6	24.0
2 Split type	0	---	1	4.0
3 Window type	5	62.5	17	68.0
None	2	25.0	1	4.0
Combination of 2 & 3	1	12.5	0	---
Public area				
1 Centralized type	0	---	6	24.0
2 Split type	1	12.5	2	8.0
3 Window type	5	62.5	15	60.0
None	0	---	1	4.0
Combination of 1 & 3	1	12.5	0	---
Combination of 2 & 3	1	12.5	1	4.0
Office				
1 Centralized type	0	---	5	20.0
2 Split type	0	---	3	12.0
3 Window type	5	62.5	16	64.0
None	1	12.5	0	---
Combination of 1 & 3	1	12.5	0	---
Combination of 2 & 3	0	---	1	4.0
No office	1	12.5	0	---
Isolation room				
1 Centralized type	0	---	2	8.0
2 Split type	0	---	2	8.0
3 Window type	6	75.0	10	40.0
None	2	25.0	11	44.0
Air freshener				
Yes	6	75.0	0	---
Public area	3	50.0	---	---
Isolation room	1	16.7	---	---
Washroom	2	33.3	---	---
Fan				
Yes	8	100.0	26	100.0
Bedroom	8	100.0	26	100.0
Public area	7	87.5	26	100.0
Office	3	37.5	24	92.3
Isolation room	6	75.0	21	80.8
Extractor fan				
Yes	8	100.0	26	100.0
Bedroom	3	37.5	16	61.5
Public area	3	37.5	11	42.3
Office	4	50.0	8	30.8
Isolation room	5	62.5	22	84.6
Washroom	6	75.0	25	96.2
Complaints on ventilation from staff or resident				
Yes	2	25.0	2	7.7

Table 6.9 Comparison on environmental hygienic aspect (cleaning frequency) among the outbreak and non-outbreak homes

Environmental hygienic aspect	n Outbreak homes	%	n Non-outbreak homes	%
Cleaning practice (per day)				
Frequency				
Bathroom				
1	7	87.5	12	46.2
2	1	12.5	7	26.9
3	0	---	5	19.2
4	0	---	1	3.8
More than 4	0	---	1	3.8
Kitchen				
1/7	0	---	1	3.8
1	8	100.0	19	73.1
2	0	---	4	15.4
3	0	---	2	7.7
Floors				
1	8	100.0	15	57.7
2	0	---	5	19.2
3	0	---	3	11.5
4	0	---	2	7.7
More than 4	0	---	1	3.8
Furniture				
1/7	1	12.5	2	7.7
1	7	87.5	19	73.1
2	0	---	4	15.4
3	0	---	1	3.8
Door handle				
1/7	1	12.5	1	3.8
3/7	0	---	1	3.8
1	7	87.5	19	73.1
2	0	---	4	15.4
3	0	---	1	3.8
Light switch				
1/7	1	12.5	2	7.7
3/7	0	---	1	3.8
1	7	87.5	18	69.2
2	0	---	4	15.4
3	0	---	1	3.8
Waste bin				
1/7	2	25.0	2	7.7
3/7	2	25.0	1	3.8
1	3	37.5	17	65.4
2	1	12.5	4	15.4
3	0	---	1	3.8
Not fix	0	---	1	3.8

Table 6.10 Comparison on environmental hygienic aspect (cleaning practice and agent) among the outbreak and non-outbreak homes

Environmental hygienic aspect	n Outbreak homes	% 8.0	n Non-outbreak homes	% 25.0
Cleaning practice				
Agent used				
Bathroom				
1:99 bleach	5	62.5	24	92.3
1:49 bleach	2	25	0	---
Dettol®	0	---	1	3.8
Kit Chi Duck®	1	12.5	1	3.8
Green water + 1: 99 blench	0	---	0	---
Kitchen				
1:99 bleach	5	62.5	25	96.2
1:49 bleach	1	12.5	0	---
70% alcohol	0	---	1	3.8
Detergent	1	12.5	0	---
Green water	1	12.5	0	---
Floors				
1:99 blench	5	62.5	26	100.0
1:49 blench	2	25	0	---
Green water	1	12.5	0	---
Furniture, door handles, light switches				
1:99 bleach	6	75	26	100.0
1:49 bleach	1	12.5	0	---
Green water	1	12.5	0	---
Waste bins				
1:99 bleach	5	62.5	26	100.0
1:49 bleach	2	25	0	---
Green water	1	12.5	0	---
Cleaning the commode				
After every use	5	62.5	16	61.5
One time per day	3	37.5	8	30.8
No commode	0	---	2	7.7
Equipment storage				
Mask	8	100.0	26	100.0
Gloves	8	100.0	26	100.0
Face shield	7	87.5	26	100.0
Goggles	8	100.0	26	100.0
Shoe protection	8	100.0	25	96.2
Hat	8	100.0	26	100.0
Protective coat	8	100.0	26	100.0

Table 6.11 Comparison on food handling practice among the outbreak and non-outbreak homes

Food handling practice	n Outbreak homes	%	n Non-outbreak homes	%
Wash hands before cooking and after toilet				
Yes	8	100.0	26	100.0
Hand-wash detergent				
Soap	8	100.0	26	100.0
Hand-wash duration				
Less than 5 seconds	0	---	1	3.8
10 to 14 seconds	1	12.5	3	11.5
15 to 19 seconds	3	37.5	3	11.5
20 seconds or more	4	50.0	19	73.1
Hands rub				
Yes	8	100.0	26	100.0
Sharing towel				
No	8	100 0	26	100.0
Wear apron during cooking				
Yes	8	100.0	19	73.1
No	0	---	7	26.9
Wear hat during work				
Yes	5	62.5	10	38.5
No	3	37.5	16	61.5
Wear Mask during work				
Yes	5	62.5	11	42.3
No	3	37.5	15	57.7
Continue to work in case of AG symptom				
Yes	0	---	1	3 8
No	8	100.0	25	96 2
Attend health talk on food handling				
Yes	8	100.0	19	73.1
No	0	---	7	26.9
Treat wound				
Sticking plaster	8	100.0	23	88.5
Wear gloves	0	---	3	11.5
How to store uncooked foods				
Refrigerate	8	100 0	25	96 2
Place at room temperature	0	---	1	3.8
Separate knife & chop board				
Yes	8	100 0	26	100 0
Defrost method				
Put at lower compartment of refrigerator	4	50.0	10	38.5
Running water	4	50.0	13	50.0

Table 6.12 Observational comparison on ventilation among the outbreak and non-outbreak homes

Observation	n Outbreak homes	%	n Non-outbreak homes	%
Ventilation				
Bedroom: Activated %				
Window				
Observation with such facility	8	100.0	25	96.2
0-30	2	25.0	9	36.0
31 - 70	1	12.5	7	28.0
71 -100	5	62.5	9	36.0
Fan				
Home with facility	8	100.0	24	92.3
0-30	7	87.5	20	83.3
31 - 70	0	---	0	---
71 -100	1	12.5	4	16.7
Air-conditioning system				
Home with facility	5	62.5	24	92.3
0	5	100.0	24	100.0
1 - 100	0	---	0	---
Extractor fan				
Home with facility	3	50.0	12	46.2
0-30	1	33.3	9	75.0
31 - 70	1	33.3	0	---
71 -100	1	33.3	3	25.0

Table 6.13 Observational comparison on environmental hygienic of public areas among the outbreak and non-outbreak homes

Observation	n Outbreak homes	%	n Non-outbreak homes	%
Environmental hygiene				
Public area				
Overall environment				
Smelly	0	---	1	3.8
Non-smelly	8	100.0	25	96.2
Fresh	8	100.0	26	100.0
Stuffy	0	---	0	---
Floors				
Clean	8	100.0	26	100.0
Dirty	0	---	0	---
Furniture				
Clean	8	100.0	25	96.2
Dirty	0	---	1	3.8
Rubbish bin				
Yes	2	25.0	14	53.8
No	6	75.0	12	46.2
Full	0	---	1	7.1
Not full	2	100.0	13	92.9
With lid	2	100.0	12	85.7
Without lid	0	---	2	14.3

Table 6.14 Observational comparison on environmental hygiene of washrooms among the outbreak and non-outbreak homes

Observation	n Outbreak homes	%	n Non-outbreak homes	%
Washroom				
Overall environment				
Smelly	0	---	3	11.5
Non-smelly	8	100.0	23	88.5
Fresh	7	87.5	22	84.6
Stuffy	1	12.5	4	15.4
Floors				
Clean	7	87.5	22	84.6
Dirty	1	12.5	4	15.4
Toilet seat				
Clean	6	75.0	22	84.6
Dirty	2	25.0	4	15.4
Without contaminant	6	75.0	22	84.6
With contaminant	2	25.0	4	15.4
Toilet flush				
Flushable	8	100.0	26	100.0
Non-flushable	0	---	0	---
Hand washing basin				
Clean	7	87.5	25	96.2
Dirty	1	12.5	1	3.8
Freely flow	7	87.5	26	100.0
Clog	1	12.5	0	---
Handwash liquid/soap				
With device, contains soap	7	87.5	18	69.2
With device, no soap	0	---	2	7.7
No device, no soap	1	12.5	6	23.1
Tissue				
With device, have tissue	1	12.5	2	7.7
With device no tissue	1	12.5	3	11.5
No device, no tissue	6	75.0	21	80.8
Hand dryer				
With device	0	---	0	---
No device	8	100.0	26	100.0
Common towel				
Yes	0	---	0	---
No	8	100.0	26	100.0
Individual towel				
Yes	1	12.5	1	3.8
No	7	87.5	25	96.2
Clean	1	100.0	1	100.0
Dirty	---		---	
Waste bin				
Yes	2	25.0	16	61.5
No	6	75.0	10	38.5
Full	0	---	1	6.3
Not full	2	100.0	15	93.8
With lid	2	100.0	14	87.5
Without lid	0	---	2	12.5

Table 6.15 Observational comparison on environmental hygienic of kitchens among the outbreak and non-outbreak homes

Observation	n Outbreak homes	%	n Non-outbreak homes	%
Kitchen				
Overall environment				
Smelly	0	---	3	11.5
Non-smelly	8	100.0	23	88.5
Floors				
Clean	7	87.5	14	53.8
Dirty	1	12.5	8	46.2
Refrigerator				
Smelly	1	12.5	3	11.5
Non-smelly	7	87.5	23	88.5
Stuffed (overcrowded)	0	---	0	---
With space	8	100.0	26	100.0
All food are well wrapped	5	62.5	19	73.1
Not all food are well wrapped	0	---	2	7.7
No food in refrigerator	3	37.5	5	19.2
cooked food up, raw down				
Yes	2	25.0	8	30.8
No	0	---	3	11.5
No cooked food storage	6	75.0	15	57.7
Freezer for raw foods				
Yes	8	100.0	24	92.3
No	0	---	2	7.7
Separate refrigerator for cooked and raw food				
Yes	2	25.0	4	15.4
No	0	---	9	34.6
No cooked food storage	6	75.0	13	50.0
Refrigerator temperature (lower part)				
0 - 4	5	83.3	10	62.5
4 - 8	1	16.7	4	25.0
>8	0	---	2	12.5
No thermometer	2	---	10	---
Working table				
Clean	8	100.0	23	88.5
Dirty	0	---	3	11.5
extractor fan				
Clean	8	100.0	24	92.3
Dirty	0	---	0	---
No device	---	---	2	7.7
Cleaning cloth				
Clean	6	75.0	18	69.2
Dirty	2	25.0	8	30.8
Apron				
Clean	7	87.5	14	53.8
Dirty	1	12.5	6	23.1
No apron for observation	---	---	6	23.1

Table 6.16 Observational comparison on isolation room condition among the outbreak and non-outbreak homes

Observation	n Outbreak homes	%	n Non-outbreak homes	%
Isolation room				
Occupied by non-ill resident				
Yes	0	---	0	---
No	8	100.0	26	100.0
Functional				
Yes	8	100.0	26	100.0
No	0	---	0	---
Resident staying in isolation room during the time of interview				
Yes	1	12.5	2	7.7
No	7	87.5	24	92.3
No. of residents				
1	0	---	2	100.0
3	1	100.0	0	---

Table 6.17 Interaction analyses between individual hygienic risk factors and the corresponding institutional factors on the experience of AG

	Factors / interactions	Wald Chi-Square	*p*-value
a	**Resident to toilet seat ratio (Seat ratio)**		
	intercept	2.22	0.13
	Hand wash practice	7.62	0.0068**
	Seat ratio	2.56	.280
	Hand wash practice* seat ratio	5.16	.080
b	**Staff to resident ratio (ICO)**		
	intercept	11.69	0.001**
	Hand wash practice	38.01	0.001**
	ICO	1.57	0.46
	Hand wash practice* ICO	0.56	0.76
c	**Staff to resident ratio (HW)**		
	intercept	4.30	0.04
	Hand wash practice	13.38	0.001**
	HW	0.66	0.96
	Hand wash practice* HW	2.98	0.56
d	**Staff to resident ratio (PCW)**		
	intercept	2.24	0.13
	Hand wash practice	5.33	0.02*
	PCW	0.63	0.73
	Hand wash practice* PCW	2.46	0.29

* $p<0.05$, ** $p<0.01$

Model selection method: Generalized Linear Model; Type of model: Binary logistic

Adjusted for significant covariate factors found in multiple conditional logistic regression by enter method with manual adjustment: Hospitalization within a month (yes vs no), self-nutrition evaluation (enough vs not enough), simplified barthel index (score. 15 or score < 15) and Alzheimer's (yes vs no).

Categorical levels for institutional factors a) seat ratio [1: 1-5, 2: 6-15, 3:>15]; b) ICO [1: 16-49, 2: 50-99, 3: 100-199, 4: 200-205]; c) HW [1: 10-19, 2: 20-29, 3:30-39, 4:40-55, 5: No HW]; d) PCW [1: 4-9, 2: 10-19, 3: 20-29]

Table 6.17 (continued) Interaction analyses between individual hygienic risk factors and the corresponding institutional factors on the experience of AG

	Factors / interactions	Wald Chi-Square	*p*-value
e	**Staff to resident ratio (RN)**		
	intercept	8.54	0.003**
	Hand wash practice	38.54	0.001**
	RN	0.45	0.80
	Hand wash practice* RN	1.47	0.48
f	**Qualification of ICO (ICO quali)**		
	intercept	3.54	0.06
	Hand wash practice	17.28	0.001**
	ICO quali	0.18	0.67
	Hand wash practice* ICO quali	0.01	0.93
g	**Availability of hand wash liquid /soap in the washroom (Soap)**		
	intercept	4.07	0.04*
	Hand wash practice	10.34	0.001**
	Soap	0.32	0.85
	Hand wash practice* Soap	1.64	0.44
h	**Frequency of bathroom cleaning practice (cleaning practice)**		
	intercept	5.61	0.02*
	Hand wash practice	9.67	0.002**
	Cleaning practice	1.33	0.51
	Hand wash practice* Cleaning practice	2.24	0.33

* $p<0.05$, ** $p<0.01$

Model selection method: Generalized Linear Model; Type of model: Binary logistic

Adjusted for significant covariate factors found in multiple conditional logistic regression by enter method with manual adjustment: Hospitalization within a month (yes vs no), self-nutrition evaluation (enough vs not enough), simplified barthel index (score . 15 or score < 15) and Alzheimer's (yes vs no).

Categorical levels for institutional factors e) RN [1:30-79, 2: 80-165, 3: No RN]; f) ICO quail [yes vs no]; g) Soap [yes vs no]; h) cleaning practice [1: 7 times per week, 2: 8-20 times per week, 3: 21 to 32 times per week]

CHAPTER 7
DISEASE BURDEN

This section describes the disease burden on the primary and secondary symptoms of the AG residents, extra workload to staff, self interpretation on the cause of AG, medication and economic cost.

7.1 Symptoms

Among the 140 case residents, 123 (88%) experienced diarrhoea. The number of diarrhoeas within 24 hours ranged from 1 to 13. Above 40% had 3 diarrhoeas while 48% had 4 to 6 times. Six (5%) residents had diarrhoea 7 or more times within 24 hours. Three of the AG residents experienced bloody diarrhoea once. The number of AG residents that experienced vomiting was (40%, n=55). The frequency ranged from 1 to 5 times, with 40% of AG residents vomiting once and over 50% vomiting 2 to 3 times within 24 hours. Only 2 (4%) of them vomited 4 to 5 times. Abdominal pain was the most common (29%) secondary symptom, followed by tired limbs (18%), extreme tiredness (17%), nausea (10%), headache (7.1%), fever (5%), and chills (2.9%). The total number of ill days ranged from 1 to 15. Approximately 40% were ill for 2 days, 22% for 3 days and a number of the AG residents were ill for 8 to 15 days. The information was collected either by direct report from the AG residents or from their medical records (Table 7.1). During the period of illness, a few of the AG residents contaminated their clothes (19%), bed sheet (16%), floor (9%), furniture (3%) and the toilet (3%) by either excrement or vomit. Over 90% were cleaned by staff immediately, and all the contaminants were cleaned up within 10 minutes (Table 7.2).

7.2 Self interpretation of the cause of AG

Most of the AG residents did not have much knowledge about the cause of their AG. No one thought it was due to person-to-person transmission while 12% (n=17) thought it was due to food-borne transmission. Among the AG residents who blamed the food for their illness, 71% ate food provided by the elderly home, while 24% (n=4) ate the food from outside but none travelled outside of Hong Kong. The incubation period referred to the time of onset, beginning when the food was consumed. It ranged from 0.5 to 12 hours. About half (n=8) of them had an incubation period of 0.5 to 6 hours, while 5 of them had a long incubation period from 7 to 12 hours, and 4 of them could not tell the exact incubation period. The foods that were thought to cause infection included a wide range of food type s. Milk (n=4) and lactobacillus drinks (n=2) were the most frequent food reported. Other foods included kiwi, rice roll, food from restaurants, marinated meat, cooked dishes, cake, BBQ pork, bread, cooked balsam pear (a kind of vegetable), and ribs (Table 7.3).

7.3 Medications, treatments and costs

Approximately 80% of the AG residents received medical consultation. 36% consulted doctors in private clinics, 27% attended the accident and emergency department (AED) of a public hospital while 28% received treatment from other health care providers such as the NGO clinic attached to the elderly homes, the CGAT doctor and the Jockey Club clinic. The fee for the whole treatment ranged from $40 to $300. The mean fee is $85. As the prime cost for cases in public AEDs

and public outpatient clinics were $720 and $260 respectively [140], the estimated cost for each AG case would be $302 (based on the 99 cases that could either report the exact amount or on cases from public AEDs and public outpatient clinics. About 30% of the fees were below $100, while about 20% were ranged from $101 to $200. Approximately half of the AG residents could not report the exact amount. Most of the fees (74%) were self-paid (including those paid by the family) while 26% were paid for by the government. There were several reasons for the AG residents (n=29) not consulting medical services. "Not severe" was recorded as the highest proportion (86%). Other reasons were: intended to wait for the faecal test result (1 resident); attended AED but without consultation because of the long waiting time (1 resident); thought that no doctor could be found during the holiday (1 resident); and no one brought her to the clinic (claimed by 1 resident) (Table 7.4).

12% (n=17) of the AG residents submitted stool samples while 1% (n=2) submitted blood samples to other agencies for laboratory testing. Among the submitted samples, 42% (n=8) were found to be *norovirus* positive, while 32% (n=6) were found to be *norovirus* negative, one was confirmed as gastroenteritis, and food allergy was reported from another case. 6% (n=9) received intravenous fluids (IV) while 8% received injections. More than 70% (n=108) received oral medication. The length of medication ranged from 1 to 14 days, with 66% taking medicine for 1 to 3 days and 32% for 4 to 7 days. Only 3% required treatment from 8 to 14 days. The medicines were mainly from prescription (94%) while 4% (n=4) got the medicine over the counter, and 3% (n=3) received medicine from the elderly homes. Most of

the medicine intakes were for the treatment of diarrhoea (78%), and vomit (19%). Antibiotics were prescribed from 2 of the AG residents. One resident took the medicine from previous consultation.

7.4 Other costs

In terms of time loss, about 8% (n=11) of AG residents claimed they miss half a day or more of recreation or vacation activities. Ten residents missed 0.5 to 3 days while one extreme case missed 11 days. Various people spend time on AG residents, including home staff (n=52), non-home staff (n=3), family members, and friends (n=23). Time spent ranged from 0.5 to 1 day. The only cost other than medical treatment was the cost for staff to accompany the resident visit the doctor. The cost ranged from $40 to $120 (Table 7.5).

In summary, the main symptom of diarrhoea was more severe than the vomiting. The percentage of case residents that experienced diarrhoea (88%) was more than doubled the percentage that experienced vomiting (40%) and the frequency and duration of the symptoms greater in diarrhoea than in vomiting. Other secondary symptoms included abdominal pain, tired limbs, extreme tiredness, nausea, headache, fever, and chills. The total number of ill days varied between two extremes of 1 to 15 days, with over 60% recovery within 2 to 3 days. Less than 20% of the residents reported soiling of their clothes and bed sheets, and less than 10% reported contamination of the floor, furniture and/or the toilet. In almost all cases, clean-up by staff was effected immediately.

Self interpretation of the cause of AG revealed that 12% of victims considered it to be food borne, while none thought their illness was due to person-to-person transmission. Approximately 80% of the AG residents received medical consultation. The fee for the whole treatment ranged from $40 to $300, with a mean fee of $85. Most of the fees were self-paid. 'Not severe' was the main reason for not consulting medical services. Only 12% of victims submitted stool samples for pathogen identification, of which only 8 were found to be *norovirus* positive. Most of the case residents received oral medication, with less than 10% receiving injections or intravenous fluid replacement therapy.

Table 7.1 Disease burden on the primary and secondary symptoms of AG among the case residents

Disease burden	n	%
Diarrhoea	123	87 9
Range	1-13	---
Diarrhoea . 3	115	82.1
Diarrhoea time(s)		
1 - 2	8	6.5
3	51	41.5
4 - 6	58	47 2
7	6	4 9
Bloody diarrhoea	3	2 4
No. of day(s) with bloody diarrhoea		
1	3	---
No. of time(s) with bloody diarrhoea		
1	3	
Vomit . 1	55	39.3
Range	1-5	
Vomit time(s)		
1	22	40 0
2-3	31	56.4
4-5	2	3 6
Related symptom(s)		
Fever	7	5
Abdominal pain	40	28.6
Headache	10	7.1
Nausea	14	10
Excessive thirst	4	2.9
Extreme tiredness	24	17.1
Tired limbs	25	17.9
Chills	4	2 9
Total no. of ill day(s)		
Range	1 -15	---
1	26	18.7
2	54	38.8
3	31	22 3
4-7	24	17 3
8-15	4	2 9
Don't know	1	---

Table 7.2 Disease burden on staff working with the AG residents

Place of excretion (diarrhoea)	n	Place of excretion (vomit)	n
Toilet	4	Sanitary bag	8
Clothes	18	Clothes	8
Bed sheet	16	Floor	13
Furniture	3	Bed sheet	6
Others	1	Furniture	1
No	89	No	23
Clean up by staff (diarrhoea)		**Clean up by staff (vomit)**	
Immediate	35	Immediate	29
Less than 5 minutes	2	Less than 5 minutes	1
5 to 9 minutes	1	5 to 9 minutes	1

Table 7.3 Disease burden on the cause of AG among the case residents

Disease burden	n	%
Self interpretation on cause of illness		
Food-borne transmission	17	12.1
Person-to-Person transmission	0	---
Don't know	123	87.9
Place of infected food consumption		
Inside elderly home	12	71
Outside elderly home (all within HK)	4	24
Don't know	1	5
Incubation period		
Range (hr)	0.5 - 12	---
0.5 - 6	8	47.1
7-12	5	29.4
Missing	4	23.5
Food causing symptoms		
Kiwi	1	6.7
Rice roll	1	6.7
Food from restaurant	1	6.7
Marinated meat	1	6.7
Cooked dishes	1	6.7
Cake	1	6.7
BBQ pork	1	6.7
Bread	1	6.7
Cooked balsam pear and ribs	1	6.7
Milk	4	26.7
Yakult	2	13.3
Don't know	2	---

Table 7.4 Disease burden on medical consultation among the case residents

Disease burden	n	%
Medical consultation		
Yes	111	79 3
No	29	20 7
Type of consultation		
Medical doctor in private outpatient clinic	42	36 2
Medical doctor in public outpatient clinic	10	8 6
Medical doctor in the AED of a hospital	31	26 7
Chinese traditional practitioner	0	---
Other health care provider	33	28 4
Specify type of medication		
CGAT doctor	9	6 0
Elderly home attached clinic	23	15 4
Jockey Club clinic	1	0 7
Fee ($)		
Range	40-300	---
Mean	85	---
100	34	30 6
101-200	22	19 8
201-300	2	1 8
Don't know	53	47 7
Person paying		
Self	80	72 1
Family	2	1 8
Government	29	26 1
Reason for not seeking medical attention		
Not severe	25	86 2
Wait for the laboratory report	1	3 4
Went to ADE, wait for too long, left without consultation	1	3 4
During holiday no doctor	1	3 4
No one brought patient to clinic	1	3 4

Table 7.5 Disease burden on medication and other costs among the case residents

Disease burden	n	%
Submit any specimen for testing		
Stool	17	12 1
Blood	2	1 4
Result		
Norovirus negative	6	31 6
Norovirus positive	8	42 1
Gastroenteritis	1	5 2
Food allergy	1	5 2
Don't know	3	15 8
Receive IV fluid	9	6 4
Injection	11	7 9
Medication		
Yes	108	77 1
No	31	22 1
Don t know	1	---
Length of medication		
1-3	71	65 7
4-7	34	31 5
8-14	3	2 8
Source of medication		
Prescribed med	101	93 5
Over the counter	4	3 7
Medicine from elderly home	3	2 8
Kind of medication		
Anti-diarrhoeal medicines	95	78 5
Anti-emetics	23	19 0
Antibiotics	2	1 7
Medicines left over from previous consultation	1	0 8
Miss half a day or more of recreation, vacation activities	11	7 9
0 5 - 3	10	7 1
11	1	0 7
Time spent on resident by others as a direct result of the illness		
Home staff	52	37 1
Family members	22	15 7
Friends	1	0 7
Non-home staff	3	2 1
No	62	44 3
Duration (day)		
0 5	73	52 1
1	5	3 6
Other costs		
Staff to accompany for doctor visit	14	10 0
Cost ($)		
40	8	5 7
100	2	1 4
120	1	0 7
Don't know	3	2 1

CHAPTER 8
DISCUSSION

In this study, we identified 140 AG cases during the data collection period, from Dec 07 to May 09. The case reports peaked in winter time, with 24 outbreaks and 57 sporadic cases identified. For every case reported, two sex and age (within 5 years) and matched elderly homes were selected as controls. The case and control groups were comparable in all demographic characteristics. Multivariate conditional logistic regression revealed 5 significant risk factors for AG infection. 'Some or never wash hands after using the toilet' recorded the highest OR. Other significant risk factors included 'self-nutrition evaluation as 'not engough'', 'having hospitalization in past month', 'SBI scored <15', and 'Alzheimer's'.

Institutional characteristics comparison between OHs and NOHs revealed that OHs had a higher median number of residents, a lower health worker to resident ratio and a less frequent routine cleaning practice than NOHs. Regarding the disease burden, the percentage of case residents that experienced diarrhoea was double the percentage that experienced vomiting. A large difference was recorded in the total number of ill days (1-15 days). The direct medical costs paid by the residents were relatively low, with a mean fee of $85 while the indirect costs included the time lost for staff, family members and friends, and cost for staff to accompany the resident to visit the doctor. In this chapter, the characteristics of AG case reports, cause of infection, disease burden, individual and institutional hygienic risks, and other

potential risk factors of AG are discussed for this study and other local and international studies.

8.1 AG case report

The sense of urgency regarding outbreak notification to the Government has increased considerably since SARS. 77% of AG notifications in 2006 were from the elderly homes themselves [5]. In our study, in addition to case notifications by elderly home staff themselves, case reports were monitored by the routine telephone call check by research assistants and by regular site visits by CGAT nurses. Case referrals from AED, PWH were also a source of case notification. These 4 routes of case notification aimed to identify any AG cases in all possible sources so as to minimize the underreporting rate. Without official statistics, the cases in our study were mainly derived from reports from the elderly homes and from surveillance by research assistants.

Seasonal trend

The trend of the monthly case report(s) in our study was comparable to the surveillance programme published by CHP (The Centre for Health Protection), HKSAR (Fig.2.7 & Fig. 4.1). In our study, case reports peaked in winter time, from Dec 08 to Feb 09. Mini peaks were observed during May 08, Jul 08 and Oct 08. A declining trend was recorded in 2009 from Jan to May. This is analogous to the pattern found by CHP, HKSAR, except the mini peak shifted from Oct 08 to Sept 08. It should be noted that the two sets of data came from quite different data sources.

The comparison only served to examine the case report data in general. Our data were restricted to the NT East district while data from CHP represented the more generalized Hong Kong situation. Peak levels were concentrated in winter; this is partly explained by the infection of *norovirus*, which is the so-called 'a winter vomiting disease' [141-143]. In the CHP surveillance programme run from August 2006 to July 2007, among the 18,636 samples collected for *norovius* idenfication in the population, the percentage of positive *norovirus* identified was ranged from 7 to 35%, while the peaks were recorded from December 2006 (35%) to January 2007 (32%) [3]. Recent local [144] and global studies [145] suggest *norovirus* variants account for the unusual seasonal pattern e.g. outbreaks recorded in summer.

Sporadic and outbreak cases

Among the 20 elderly homes reporting either sporadic or outbreak cases, 7 encountered both sporadic and outbreak cases, while 12 encountered sporadic cases only and one experienced outbreak cases only. The top 3 homes recorded 38 (N5), 19 (S2) and 15 (T2) case reports, contributing to over 50% of the total cases, in which all are subvented homes. Among the 24 outbreak cases, half (12) were small outbreaks involving 2 residents, 7 involved 3-5 residents, while 5 involved 6-8 residents. There is little published data on AG sporadic cases in elderly homes because AG is considered to cause a trivial disease burden. The numbers of residents involved in outbreaks were small in our study. All published cases had more than 10 infected residents[15, 20] and it was not uncommon to record more than 100 infected in some large scale elderly homes worldwide [18, 21, 72]. This might be due

to reporting bias as published outbreak cases tend to report large scale outbreaks. In our study, overestimation of outbreak numbers may exist. Two co-existing AG residents may have independent causes and should not be counted as an outbreak. However, as they were living in the same elderly home, the possibility of person-to-person transmission could not be eliminated. As a result, 12 outbreaks involving only 2 residents were recorded according to the case definition.

Attack rate

The attack rate (number of AG cases / total number of residents) was low (median: 1.89%; range: 0.8 –15.8%; IQR: 1.3% - 4.1%) in our study comparing with pervious data published locally (median: 7%; IQR: 4%-13%) from a retrospective cohort elderly home study [5] and internationally from various elderly outbreaks in Israel (32%), Rotterdam (48%)[18], US (52%)[21], and Austria (74%). It should be noted that some studies may use the laboratory confirmed cases but not the AG case to calculate the attack rate. So the calculated attack rate may be much lower as it was common that many of the cases did not send faecal samples to the laboratory for pathogen identification. Extra care in data interpretation should be taken during cross studies comparison [71].

8.2 Disease burden

The US Food Administration estimates that 2-3% of all AG illnesses develop secondary chronic sequelae. These sequelae can occur in any part of the body such as joints, nervous system, kidneys or heart. One chronic sequela from *Campylobacter* infection that affects the elderly in particular is Guillain-Barre Syndrome, an acute immune-mediated polyneuropathy that, at its most severe, can cause paralysis, respiratory insufficiency and autonomic failure leading to death. Our study on the other hand mainly concentrated on the short term burden on symptoms. In a local retrospective cohort study, AG was noted to be the most common infectious outbreak (35%) in the community, followed by respiratory infection (28%) and skin infection (8%). Among the community AG outbreaks (n=495), elderly homes accounted for about half (n=218; 44%) of the cases reported to Department of Health (DH) in 2006. Within the infectious case reports from elderly homes (n=376), AG also accounted the highest proportion (58%) followed by scabies (28.2%), upper respiratory infection (9.6%), and influenza-like-illness. In that study, Kowloon (42%) recorded the highest proportion of outbreaks, with NT East (23%), NT West (23%) and HK island (12%) following. Private homes were less commonly involved in AG outbreaks. [5]. Our results showed similar results. Among the 140 reported cases, 40% came from private homes, and private homes only accounted for 21% of the total outbreak cases (n=24). The case report rate was more skewed to the subvented homes as only 5 of them were recruited, compared with 29 private homes recruited.

Symptoms

In our study, the duration of symptoms ranged from 1 to 15 days, with 79% achieving complete recovery within 3 days. This is comparable to AG symptoms duration reported in other localities. A prospective study focused on *norovirus* outbreaks in Avon, England involving outbreak surveillance on health care settings, 75% of the residents recovered within 2 days in elderly homes, while 75% of hospital patients . 65 lasted for 3 days [132]. Another study was found in Washington in 1996 involving 52 residents and 34 staff in a geriatric Long-Term-Care Facility (LTCF). Diarrhoea was noted in 90%, vomiting in 70%, and fever in 12%. The duration of illness ranged from 1 to 14 days with a median of 2 days [46]. In our study, 82% of the cases had 3 or more episodes of diarrhoea, while a lower rate of vomiting (39%) and fever (5%) was recorded. The most common secondary symptoms in our study were extreme tiredness and tired limbs, followed by nausea, headache, excessive thirst, and chills, while stomach cramps, headache, nausea, and chills were also reported in some previous studies [15, 21].

Medication

In our study, approximately 80% of the case residents consulted doctors and the mean cost for medical services including medication was $302. The cost was higher compared with the study by Hellard [75] in an Australian study analyzed the average cost of prescribed medication per visit at A$6.83. The cost of AG in elderly home residents seemed to be lower than the working group as the indirect cost of sick days from work was counted as indirect cost. The cost of a single episode of AG in the US was estimated to be US$348, of which US$87 was medical costs and

US$261 was indirect costs[33]. Even if the person did not consult a doctor, the indirect cost was estimated to be US$215. A study in New Zealand estimated the cost of AG per case to be NZ$462 [146]. However, we should not neglect other indirect costs such as time off from work from friends or family members to take care the residents, the extra work for staff over care and disinfection measures, and hospitalization. In most of the countries reported, the highest hospitalization rate was found in the elderly group [84]. In our study, about 40% of the home staff and 16% of the family members or friends of the residents spent at least half a day taking care of AG victims. The only indirect cost identified in our study was the cost for staff to accompany the resident to see a doctor (range: $40 – $120), accounting for 25% (14/55) extra staff hours.

It should be noted that a small portion (10%, 3/29) of the ill residents who did not seek medical consultation made their decision reluctantly, for the reasons described above (the long waiting time in the accident and emergency department, misconceptions about the availability of a doctor during a public holiday, and and lack of availability of an escort). 'Not severe' was the major reason for the others who did not consult a doctor. For this group of case residents, if their AG was not treated properly and if the AG was caused by infectious pathogen, there was a high chance of pathogen transmission and in turn, an outbreak would result. In our study, 19% (16/83) of the residents from outbreak cases did not seek medical consultation. In two larger outbreaks, 4 out of 5 and 1 out of 8 residents did not seek medical consultation, although they were not the index cases. A higher proportion of cases

that did not seek medical consultation was recorded in the sporadic cases 23% (13/57).

Antibiotic therapy is rare among AG patients worldwide [147]. In population surveys, antibiotic usage for the treatment of AG was reported at 8.3% in the US[74], 5.6% in Ireland[29], and 3.8% in Canada [28]and 3.6 in Australia[148]. Our result of 1.9% was the lowest compared with other countries, although our study was not population based. Recomomdation and guidelines on empiric antibiotic therepy for AG patients were laid down by aurthoritative organizations [149]such as the American College of Gastroenterology[150], the Infectious Diseases Society of America, [147]and the British Society for the Study of Infection [151]. The guidelines state that empiric antibiotic therepy should only be considered for adult patients if dysenteric symptoms (fever, bloody diarrhoea, and abdominal pain) are present with a positive bacterial stool culture. As few cases had pathogen laboratory confirmation and the fever rate was low (5%) in this study, which explains the low antibiotic treatment rate.

8.3 Cause of infection

Food-borne AG outbreaks were extremely rare in the elderly homes in Hong Kong, most probably because of the traditional food preferences in the Chinese elderly who prefer hot and cooked dishes, and the strict food safety measures adopted in the elderly homes[5]. In our study, 14% of the AG residents believed their cases were due to food-borne infection. However, many of the suspected foods that

caused infections were ready-to-eat foods and were not prepared by the elderly homes e.g. fruit, bread and cake etc. Some were even not consumed in the elderly homes. Suspected foods that were prepared by the elderly homes were all reported from sporadic cases. However, a larger scale outbreak should be the result if the suspected foods were the source of the pathogens, as all residents shared the same meals in the same elderly home. As a result, this may indicate a wrong interpretation. Due to practical issues, the suspected problematic foods were not collected for pathogen identification. As a result, no confirmed food-borne AG cases could be concluded in this study. AG outbreaks caused by food-borne transmission have been recorded worldwide. One example was a *Salmonella Enteritidis* outbreak involving 94 residents in a large nursing home in Hamburg, Germany. Contaminated cake was found to be the source of the pathogens. The cake was probably contaminated by improper storage under high ambient summer temperatures and failure to keep the cake refrigerated[65]. A 2008 retrospective cohort study in Spain concluded the consumption of tap water contributed to the cause, presenting a relative risk (RR) of 4.03 (95%CI: 1.4 – 11.4) [152].

On the other hand, the cause of AG infection was mainly suspected to be person-to-person transmission in most published outbreaks [21. 69. 152]. A typical AG outbreak was recorded in an elderly home community which contained 54 elderly homes in the Tel-Aviv district Israel. This outbreak involved 246 residents in 6 elderly homes. The outbreaks lasted for a month from Apr to May 2002 with different set times among the six elderly homes. Sharing of staff between several elderly homes was the identified cause [72]. In our study, a similar elderly home

community, composed of about 10 elderly homes, was located in Ku Tung, Sheung Shui with no such connected outbreaks recorded. To our knowledge, no sharing of staff was adopted as all the elderly homes in this village are independently run.

It is reasonable to suspect that the origin of sporadic cases or AG outbreaks in elderly homes comes from the community by person-to-person transmission. Transmission may be through the home's staff or visitors, or from hospital or other locations outside the elderly homes. In our study, hospitalization within a month was found to be a significant risk factor (Adjusted-OR: 2.95; 95%CI: 1.14 – 7.62), while being away from elderly home during the week preceding the interview was also found to be a risk factor for AG, although it was not statistically significant (Adjusted OR: 1.61; 95%CI: 0.82 – 3.14). No causal relationship was found between being visited by visitor and AG (Adjusted OR: 0.97;95%CI: 0.49 – 1.92). In turn, AG pathogens could be spread to hospital by AG residents living in elderly homes. An outbreak was recorded in Austria in 2004, affecting 10 of 46 (21.7%) other hospital patients and 18 of 60 (30%) members of the hospital staff. A causal relationship between the two institutional clusters was confirmed, and identified *Norovirus* genotype GII.4 was the causative pathogen [20]. In our study, due to limited resources, we did not follow up whether the AG cases were hospitalized and whether hospitalization caused a second cluster of AG outbreak within the hospital.

Transmission from staff was not specifically investigated in our study. Internationally, such transmission was recorded in a large scale outbreak involving

62 (51%) residents and 64 (47%) staff in an elderly home in Maryland, USA [15]. In this outbreak, a nurse with severe diarrhoea for three days continued to work. She dispensed medications and prepared apple juice for the residents. Another nurse was infected after working with the infected nurse, she again continued to work, dispensing ice and performing direct patient care. This outbreak happened in 1994 when knowledge and policy on infection control measures over restricting ill employees from working were weak. Sick leave enforcement in reduction of AG outbreaks was discussed by Gellert [153] . In our study, not all elderly homes maintained staff health records. The majority of staff needed to present a certificate for sick leave, opening up the possibility of AG staff continuing to work if he or she had not consulted a doctor and therefore did not have a sick leave certificate. As previously mentioned, a chef from our study claimed he or she would continue to work in case of AG because of staff shortages. These problems should be of great concern and should be further investigated to solve it.

A sporadic case could develop into an outbreak if the case was not recognized and treated at once. In our study, residents who had contact with AG residents had a higher risk of developing AG, although the risk was not statistically significant (Adjusted- OR: 1.35; 95%CI: 0.46 – 3.94). In addition to direct infection from person-to-person transmission, infection can be transmitted through environmental surface contamination. In an investigation of a *norovirus* outbreak in Philadelphia 2002, which involved 127 residents (52%) and 84 (46%) employees, environmental surface contamination explained the large and prolonged outbreak.

Environmental swabs were collected two weeks after the outbreak peak with an initial thorough cleaning of the elderly homes. *Norovirus* still existed on the toilet seats and bed rails of the case-resident rooms, handrails in the central area of wards and buttons in the staff elevators, indicating that the virus was widely spread inside the case rooms, and even the common and staff areas. [21]. Surface contamination is a common source of AG transmission when people are gathered in an enclosed area. The pathogens can be transmitted by airborne droplets produced during vomiting [14. 154. 155] . Such AG outbreaks were also recorded in other settings, such as a concert hall (contaminated object: seat in the auditorium) [97], in a hotel (contaminated objects: carpet, toilet rims and seats, handles, taps, basins and surfaces, tables, mantlepieces, light fittings, telephones, door handles and cushions) [13], in a rehabilitation centre (contaminated objects: the handle on an ultrasound physiotherapy instrument, a bathroom door handle, toilet seats) [98], in a hospital (contaminated objects: lockers, curtains, commodes), [96] and on a cruise ship (contaminated object: communal bathroom) [107]. Due to limited resources, hygienic conditions were studied in general by observation in this study. No environmental swabs were taken to investigate the pathogenic source or to trace the spreading route by the contaminants.

Airborne transmission of AG has been suggested since the 1980s in several investigations of outbreaks in areas such as a hospital [154], a cruise ship, [107] and a hotel [156]. However, there is disagreement among scientists over whether the pathogen is transmitted by the respiratory tract or by ingestion of pathogen particle droplets during vomiting. A more recent study by Mark, P.J. [14] suggested airborne

transmission of *Norovirus* in a hotel restaurant. He argued that the dose response pattern with distance from the vomiter and no infection in the next separate restaurant supported the airborne transmission theory. However, the writer agreed with the possibility of aerosolization of virus particles leading to the contamination of food or hands and subsequent ingestion of the virus. No evidence has been found to support airborne transmission, as no infectious pathogen has been found in respiratory mucosal cells [14].

8.4 Individual hygienic risk factors

Hand hygiene

Disinfection mechanism

In most venues, including residential homes, office buildings, public areas, and all of the elderly homes in our study, non-medicated soaps are placed and used in the toilets. They are detergent-based products, available in various forms, liquid being the most commonly used. The cleaning activity is due to the detergent property of the soap but there is no antimicrobial activity [157].The cleaning effect is due to the reduction of microorganisms and viruses by mechanical removal (through rubbing) of loosely adherent microorganisms from the hands. Several studies have been conducted to investigate the effect of hand-washing with plain soap over time with different artificial contaminants like *E. coli*[158], *S. aureus,* [159] and *rotavirus*[160]. The mean contaminants removal rate increased from 0.6 – 1.1 to 1.37 – 3 $\log_{10}$ unit, when the duration of hand-washing increased from 15s to 30s [157. 159. 161. 162]. The reduction rate did not drop further when the hand-washing duration increased further

from 30s to 1 min. The contaminants reduction rate decreased slightly from 1.37 – 3 to 2.6 – 3.23 $\log_{10}$ unit [157-159, 162, 163]. The data above suggest that simple hand-washing had some effect over disinfection. However, in reality, the hand wash duration was found to be less than 10 seconds in many published data[164-168]. As a result, short hand wash duration may be an important risk factor on AG infection.

In our study, hand wash duration was not found to be a significant risk factor for AG in the multivariate analysis, although a risk trend was found without statistical significance. An adjusted OR of 1.51 (95%CI: 0.57 – 3.98) was found for a hand wash duration of 9 sec or less [Ref group: . 10sec]. The hand wash practice information including the hand wash duration, hand rub practice and soap use were narrated by the residents without actual observation. For those who could not recall, we asked for a mock hand wash procedure and recorded the details. This may derive an information bias. The practice of using 'wet tissue paper/alcoholic gel/sterilized cloth' scored a very high OR of AG infection in the univariate conditional logistic regression. This may be due to the confounding effect of residents having Alzheimer's disease. They had poor mobility in general and could not practice hand washing in the toilet. As a result, they used 'wet tissue paper/alcoholic gel/sterilized cloth' instead. However, this might not be the real situation as information of the residents with Alzhimer's were proxy by staff of the elderly homes and might result in reporting bias.

Intervention studies

Three systemic reviews of the effectiveness of hand hygiene interventions towards AG were found in the literature. A report from Aiello A.E. et al. [169] showed that improvements in hand hygiene resulted in reductions in gastrointestinal illness of 31% (95%CI: 0.19 – 0.42), while the most beneficial intervention was the hand hygiene education with the use of non-antibacterial soap. In the study by Curtis and Cairncross [89], data showed hand-washing could reduce diarrhoea risk by 47%, and 44% for hand-washing with soap, while in the study by Fewtrell [170], which focused on less developed countries, hand washing was found to be a protective factor with the relative risk estimated between 0.63 and 0.75.

In our study, 'Sometimes or never wash hands after toilet' (OR:3.09; 95%CI: 1.28 – 7.42) was found to be a significant risk factor for AG, while no such correlation was found for hand wash practice before meals and the practice of soap use. The practice was found to have no intereaction with institutional characteristics. The potential confounding effect on institutional data was eliminated as cases and controls were selected from the same elderly homes. The odds ratio indicated the risk to get AG infection between residents with different hand wash behaviour, in which the hand washing behaviour represented the possible transmission route. From the result, we can presume the toilet is the most probable place for pathogen transmission, and hands are the likely vehicle for the transmission of pathogens into our bodies. This is consistent with other studies [85. 89. 169. 170]. In our study, more residents paid attention to the hand wash practice after visiting the toilet than the

hand wash practice before meals. 90% (286/319) claimed they washed their hands every time after visiting the toilet, compared to a less extent of 57% before meals (229/399). The data had already excluded those who used nappies (n=101), were tube-fed, or fed by staff (n=21). 18% (71/399) of the residents replied that they washed their hands sometimes and 13% would not wash their hands before meals. A similar phenomenon of not enforcing the hand wash practice before meals was observed in a cross-sectional survey conducted in the UK[171]. The study investigated the hygiene behaviour and knowledge of a group of nurses. Eighty-five percent of the nurses said they always encouraged patients to wash their hands after visiting the toilet, but only 23% always encouraged them to wash their hands prior to meals. In our study, 12% reported they used either a dry cloth or sterilized cloth. A dry cloth may not be effective in germ removal as germs may not be transferred from hands onto the dry cloth easily by mechanical action. On the other hand, a sterilized cloth may be a better choice in hand disinfection. 'Sterilized cloth' refers to cloth that was disinfected by either heat or a sterilizing agent such as Dettol® used in domestic households. However, for those who answered, 'use of sterilized cloth', 94% (32/34) were answered by proxy staff. Information bias might arise. Questions on how the cloth was sterilized and how they were distributed to the residents were not followed up. As only 3 residents claimed they would share towels with others, this calls into question the accuracy of the answers on 'use of sterilized cloth' to clean hands before meals.

Guideline and campaigns

A simple hand wash is a practical and cost-effective means not only in AG reduction, but also in other healthcare-associated infections[172]. The Word Health Organization (WHO) has adopted hand hygiene improvement in healthcare facilities worldwide. The First Global Patient Safety Challenge of the WHO World Alliance for Patient Safety was launched in 2005. It has developed the Guidelines for hand hygiene in healthcare as one of its principal actions [173]. In Hong Kong, The Centre for Health Protection (CHP) also promotes the hand-washing technique[174]. The procedures listed were almost the same as the ones listed by the World Health Organization (WHO) [175].

The procedures from CHP are as follows:

1. Wet hands under running water.
2. Apply liquid soap and rub hands together to make a soapy lather.
3. Away from the running water, rub the palms, back of hands, between fingers, back of fingers, thumbs, finger tips and wrists. Do this for at least 20 seconds. (while WHO suggested the entire procedure from step 1 to 6 should be within 40-60 sec)
4. Rinse hands thoroughly under running water.
5. Dry hands thoroughly with either a clean cotton towel, a paper towel, or a hand dryer.
6. The cleaned hands should not touch the water tap directly again.

- The tap may be turned off by using the towel wrapping the faucet; or after splashing water to clean the faucet.

Please note:

- Towels should never be shared.
- Used paper towel should be properly disposed of.
- Personal towels to be reused must be stored properly and washed at least once daily. It is even better to have more than one towel for frequent replacement.

Compared with our study, some hand washing steps were not strictly followed. Nearly all staff of the elderly homes (34/36) claimed they taught the residents the hand wash procedure and when to wash their hands. Among the 330 (79%) residents who had a hand wash practice, the most common hand wash duration was 5 to 9 sec (37%), followed by <5 secs (17%) and then 10 to 14 secs (15%). Only 5% had a hand wash time over 20 secs. 71% applied soap and nearly all residents (97%) had a hand rubbing practice. The hand-washing practice of the chefs was satisfactory, 68% had a hand wash time of over 20 secs, and all chefs applied soap, with hand rubbing and did not share towels. However, 21% (n=7) of the elderly homes did not have soap facility in the toilet and 2 did not refill the empty liquid soap dispensers. In other observational studies, the duration of hand wash time by health care workers (HCWs) ranged between 6.6 – 24.0 seconds [176-179]. Hand-washing for 20 seconds is generally recommended for decontaminating hands to reduce cross-infection risks in hospitals and after visiting the toilet[88]. Using a thorough, 1 min hand-washing technique was able to remove *norovirus* from faecally contaminated hands[23]. The questionnaire in our study did not ask for information on the hand drying method and method used for turning off the tap. We were told by the residents and staff that most

of the residents used their own towel located in their bedroom to dry their hand s, and that they used bare hands to turn off the taps, as most of the taps were not automatic. Short hand wash duration was the main problem identified. Guidelines from CHP suggest that the hand rubbing step should be maintained for 20 secs. In reality, most of the residents (88%) had a hand wash duration . 14 secs for the whole process , and step 6 of turning off the tap without direct touching is seldom followed. It was observed that AG pathogens were identified on the washroom tap in some previous studies during AG outbreak[13]. This suggests that turning off the tap with bare hands may result in transfer of pathogens onto the hands and may therefore be a reason for the spreading of AG pathogens.

In addition to the implementation of guidelines, WHO also recommends multi-faceted strategies to increase compliance with hand hygiene. Magiorakos AP et al. [180] reviewed hand hygiene campaigns in European countries from 2000 to 2009 and found that 13 countries had organized at least one national hand hygiene campaign, including Belgium, France, Germany, Italy and Norway. Some reported regional and local hand hygiene activities. In most of the campaigns, slogans, press conferences, press releases, leaflets, posters and a dedicated website were employed to get the campaign message accross. One example of a website from the UK under the 'Clean your hands' campaigns listed the aims, goals, projects, facts, guidelines and resources on hand hygiene[181] . The principles of these campaigns aimed to work on multiple levels within healthcare systems by education, evaluation an d providing feedback, in order to improve hand hygiene compliance[180]. No published

information on hand hygiene campaigns could be found locally. Guidelines, posters and TV advertisements about hand hygiene have been launched by the CHP in Hong Kong since 2003 [3].

Alcohol-based hand gel

The majority of alcohol-based hand antiseptics contain either isopropanol, ethanol, n-propanol, or a combination of the two compounds [182]. The antimicrobial activity of alcohols can be attributed to their ability to denature protein. The optimal concentration of alcohol should range from 60-95%; a higher concentration cannot give a better antiseptic effect but will be less potent because protein cannot be denatured easily in the absence of water[182, 183]. In term of its effectiveness, alcohol has outstanding in vitro germicidal activity against gram-positive and gram-negative vegetative bacteria, including multidrug-resistant pathogens like Methicillin-residant *staphylococcus aureus* (MRSA) and various fungi. Further, certain enveloped (lipophilic) viruses, such as human immunodeficiency virus (HIV) and influenza virus are also susceptible to alcohol when tested in vitro[184]. Despite its antiseptic effects against these organisms, alcohol has very poor activity against bacterial spores, protozoan oocysts, and certain non-enveloped (nonlipophilic) viruses. As a result, alcohol-based hand rub may not be effective against *norovirus,* theoretically, as it is a non-enveloped virus. However, some studies suggest its effectiveness on controlling *norovirus* outbreak[185]. A recent study reported a new ethanol-based hand sanitizer containing a synergistic blend of polyquaternium polymer and organic acid,

which is active against viruses, including *norovirus*. Its effectiveness was tested in vitro and in vivo [186].

Many studies have suggested alcohol-based hand gel is more effective for standard hand washing than soap or even antimicrobial soaps [187-191]. However, its efficacy is affected by several factors including the types of alcohol used, concentration of alcohol, contact time, volume of alcohol used, and whether the hands are wet when the alcohol is applied. Some studies showed that applying small volumes (0.2-0.5ml) of the gel was no more effective than washing hands with plain soap and water[192, 193]. In our study, none of the residents reported using alcohol-based hand gel to wash their hands after using the toilet and before meals. For routine practice, hand wash with soap and water is more convenient and economical. Moreover, an alcohol-based hand gel may not be effective enough to disinfect AG pathogens such as *norovirus*. The gel may be suitable for those who have difficulty in mobility, or before snack consumption.

Attitudes and real-life situations

A good hand wash practice is not only a simple and effective way for preventing AG but also one of the most important infection control measures for preventing healthcare-associated infections. The hand wash practice of both residents and staff are influenced by factors such as facilities, equipment, knowledge, and attitude [194]. Besides the hand hygiene of residents, the hand hygiene of staff is of equal importance, especially those who come into close contact with residents, and

those involved in meal preparation and distribution. Several studies have been conducted to investigate the perceptions, attitudes, knowledge and behaviour towards the hand hygiene practice of the health care professionals [171] [194] [194-198]. In a self-administered survey conducted in 13 nursing homes in south eastern Michigan, less than 40% of the staff identified correct duration of hand-washing, about 40% did not notice hand gel recommendations, and over 50% claimed they had difficulty in adhering to hand hygiene guidelines[195]. As the survey was conducted by voluntary recruitment, this might induce selection bias and the author suggested the subjects were more concerned with infection control procedures compared to the general population. However, their hand hygiene practice was not satisfactory and might even be worse than stated. Another hospital-based qualitative survey conducted in China discussed the potential ways of improving hand hygiene practices [194]. Staff in the hospital setting were knowledgeable about hand hygiene practices and viewed proper hand hygiene an important issue for infection control. However, limited resources and lack of organizational authority and personnel in the infection control departments limited the improvement in hand hygiene [194].

In our study, staff claimed they paid close attention to the hand hygiene practice themselves and to the residents. They were knowledgeable towards hand hygiene practice. ICOs from all elderly homes (n=34) replied stated that their members of staff would wash their hands with soap and change gloves immediately after handling AG contaminated items, to prevent cross contamination. However, this could not be verified. Researchers have suggested healthcare professionals clean

their hands much less often than they say they do [199]. A study aimed to investigate the discrepancy between self-reported and observed hand hygiene behaviour in healthcare professionals was conducted in the UK [200]. The results from this study showed that observed practice was unrelated to intention and self-reported behaviour and the observed hand hygiene practice was poor. For example, only 16% washed their hands both before and after contact with MRSA patients. Low compliance rate (17.4%) was also found in a Canadian study conducted by Surgeoner on the hand hygiene practice in university students in Ontario. [201]. In our study, we did not perform on site hand wash observation of the residents and staff to check their compliance. However, we interviewed a CGAT nurse during questionnaire development. She said it was not uncommon to observe care workers keeping the same pair of gloves on between handling the adult nappies and the tube feeding equipment, with no hand washing in between. She suggested the behaviour was due to the heavy work load of the care workers rather than through lack of knowledge.

Theories and intervention to improve hand hygiene behaviour

Lack of time, high workload, understaffing, inaccessibility of disinfection agents, inconvenience of sink location, and prioritizing patients needs, have also been identified by HCWs as barriers to hand hygiene[172, 182, 202-204]. Besides, studies further pointed out that the proper hand hygiene compliance by health care workers was unsatisfactory. Health care providers exaggerated their hand washing frequency and reported a much higher compliance rate.[205, 206]. This act of ingenuousness may

be a simple face-saving device by HCWs not wishing to get into trouble or, as some researchers suggest, it may be the result of self-deception, in that the HCWs genuinely but inaccurately believe their claims. Therefore, it is always difficult to drive a behaviour change as people think they are already doing the right thing [196, 207]. To counter this, the Stages of Change (SOC) Model was suggested by Trunnell EP & Write GL which could be applied to hand hygiene practice to both health care providers, and the target groups [196]. This model proposed a five-stage progress starting from 'Precontemplation' is the first stage, at which people avoid recognizing the problem, so that they are unaware the need to change. 'Contemplation' is the stage of awareness of the need to change but reluctance to change. 'Preparation' is the stage at which people plan and make ready for imminent change while 'Action' is the stage at which people begin to change by taking small steps and progressing towards a goal. The final stage, 'Maintenance' is the stage at which the goal is maintained through prompts and rewards. Many interventions have been conducted to improve the compliance rate towards hand washing practice, and most of them show promising results[202, 208-211]. The contents of the interventions included educational videos, posters, brochures, bulletins, lectures, illustrations, and distribution of hand sanitizing gel [212-214]. Besides, organisational change theory which focus on the use of indicators to develop organisational arrangements to support the delivery of health care is more applicable to motivate health care providers [215]. Several studies illustrate the application of this theory to improve the health care service in different settings [216-219].

In Hong Kong, similar interventions have been conducted in the neonatal intensive care unit in Queen Mary Hospital. Improvement in hand hygiene compliance in both doctors and nurses was observed after the intervention [220] . However, no such intervention programme has been tried in elderly homes in Hong Kong. The results of our study revealed the problems in the current hand hygiene practice, especially in hand wash duration, the hand wash practice before meals and soap provision in the toilets. This supports a hand hygiene intervention programme in elderly homes to arouse the awareness of both staff and residents.

Other individual hygiene practices

Other individual hygiene practices like teeth brushing (OR:4.33;95%CI: 1.25 – 15.20) and the use of unclean water for taking a bath (OR:6.50; 95%CI: 1.47 – 28.80) have been suggested as risk factors for AG from Gasem M.H. study in Indonesia[95]. In our study, other individual hygiene practices like bathing and cloth changing frequency were not found to be significant risk factors for AG. Nearly all (98%) of our subjects take a bath and change clothes everyday or once every other day, depending on the season and the practice of the elderly homes. This may reflect that the AG pathogens are less likely transported by the clothes and other body parts, as residents have little physical contact with each. Person-to-person transmission is mostly likely due to aerosolization of viral particles during vomiting and hand contact to the contaminated objects, but not direct skin contact [13-15]. Therefore, hand hygiene seems to offer the most effective defence in AG prevention.

8.5 Institutional hygienic risk factors

Due to the small number of homes recruited, descriptive analysis was used to compare the institutional data. Some of the factors below were related to hygiene factors indirectly. As no OR were calculated, risk trend and behaviour, instead of risk factors towards AG outbreak in elderly homes are discussed.

Staffing

Staff ratio

Previous studies have shown that poor staff to resident ratio (understaffing) may be one of the risk factors for AG outbreak in elderly homes [21, 71, 81, 81, 152]. In a cohort study of an outbreak of viral gastroenteritis in a nursing home for elderly in Majorca, Spain, the author described the greatest risk of becoming ill in the group of dependent residents was due to the staff-initiated person-to-person transmission. In this group of residents, the health worker per resident ratio was one to 12 [152]. In Hong Kong under the Residential Care Homes (Elderly Persons) Ordinance (Cap.459A Sect 18), a general guideline of the HW to resident ratio of 1:30 is recommended [139]. In our study, 74% (n=25) of the elderly homes fulfilled this guideline while 2 elderly homes did not have HW. A higher proportion (81%) of the non-outbreak homes than the outbreak homes (50%) fulfilled the guideline. Although all elderly homes have a PCW to resident ratio of less than 1:30, PCWs did not have formal training and may not be adequately prepared to handle infection control duties. In a *norovirus* outbreak at a long-term-care facility in Philadelphia, although usual nurse-to-resident ratios were maintained during the outbreak, the staff replacing the ill caregivers may have been less skilled [21].

The practice of AG staff members continuing to work should be prohibited. [15]. However, this arouses the problem of decreasing the staff to resident ratio. In an *E.Coli* O157 outbreak investigation, the author concluded the exclusion of symptomatic staff critically reduced staff numbers and the home administration was slow to mobilize staff from other sites to make up for the shortfalls [71]. In Hong Kong, staff of the elderly homes are seldom transferred from one home to another, as most are individually run. In fact this action should not be encouraged as this may induce cross home infection. the HWs and the PCWs claimed they are much busier during an AG outbreak, making it more difficult to take care the ill residents and to enforce infection control practices like more frequent cleaning and extra disinfection. In some situations, staff were reluctant to report symptoms for fear of losing wages due to sickness absence [71]. However, they were unable to identify the greater loss if the AG illness evolved into an outbreak. In our study, 6 owners of elderly homes are HW and are included in the ratio calculation. As owners may not be involved as much work as normal HWs, the HW to resident ratio may not reflect the real situation.

Infection control staff

As recommended by the Department of Health (DH), HKSAR, all elderly homes should appoint either a nurse or a health worker as an Infection Control Officer (ICO), who is the key person responsible for dealing with matters related to infection control and prevention of the spread of infectious diseases [139]. In our study,

all elderly homes had ICOs but not all (85%) met the qualification requirements. Guidelines and duties of ICOs were publicized by the DH Elderly Health Service Team [139]. Their duties mainly included coordinating and implementing all matters related to infection control, disseminating updated information and guidelines on infection control to all staff, arranging staff training on infection control, overseeing the proper disinfection of all medical equipment , and supervising staff on the proper application of disposal of personal protective equipment (PPE). In case of a suspected outbreak, ICOs have the responsibility to notify the Central Notification Office (CENO) under CHP, and the Licensing Office of Residential Care Homes for the Elderly of the Social Welfare Department for follow-up investigation. If the home is covered by CGAT, CGAT should also be informed. In our study, all homes were covered by CGAT. The ICOs of our study are knowledgeable about infection control measures in general. Most were correct in disinfection and isolation measures during outbreaks and they all have adequate storage of PPE. However, they did not strictly follow the notification system. About 80% would notify CENO (either CHP or HA) while 68% would notify CGAT. Less than half (44%) would report to SWD. The unpublished cases may lead to a delay in infection control policy and lead to a larger outbreak. On the other hand, although it is not required for an elderly home to employ a registered nurse (RN), half of the outbreak homes and 27% of the non-outbreak homes had an RN. As RNs are expected to be more skilled and knowledgeable on infection control measures, they are helpful in supplementing the ICO to maintain infection control practice. OHs had more RNs and ICOs than NOHs. This may indicate that number of supervisory staff is not a critical factor for AG

outbreak, provided that there was at least one qualified ICOs in the elderly homes. Number of frontline staff such as HWs and PCWs may be more important to prevent AG outbreak as they were the care givers and the cleaning workers.

Clean and dirty work sharing among staff

Some studies have demonstrated rotation of staff from clean to dirty jobs together with the practice of hanging clean and used uniforms side by side are potential risk factors for AG outbreak [71]. If disinfection procedures are not carried out thoroughly after dirty jobs, AG pathogens can be easily transmitted by person-to-person transmission or surface contamination. In reality, it is common and unavoidable for staff to handle both clean and dirty tasks. The key factor is whether proper disinfection procedure has been done in between the two types of task. This depends highly on self discipline and the infection control policy of the elderly home. In our study, all homes claimed they changed gloves and used soap to wash hands after handling contaminants. However, not all homes used masks (74%) and gloves (91%) to handle these contaminants. Some HWs and PCWs may become quite casual in their handling of vomit and excreta as these are part of their daily routine. Policies targeting on the use of personal protective equipment during handling contaminants should be imposed and reinforced, especially during the exchange of dirty and clean jobs.

Home setting

General setting

There is little published data on the correlation between home setting and AG outbreak in elderly homes and research output mainly focuses on the outbreak origin,

for example, tracing of food-borne infection and the transmission vehicle for person-to-person transmission[15] [65]. This study investigated the home setting factors in relation to AG in Hong Kong elderly homes. Outbreak homes are larger in size than the non-outbreak home in general in term of number of residents, rooms and room capacity. This seems to be logical as more people living together have a higher chance of infection once the source of the origin cannot not be controlled. However, the research could not confirm whether smaller private homes had a higher underreporting rate. Among the 39 cases living in elderly homes with both single rooms and partitions, there was little difference in room types and room capacity between the case and control residents. In general, a larger proportion lived in partitions (69.2% in case group; 73.1% in control group). Theoretically, living in partition increases the risk of infection, compared with living in a single room, as the partition is quite basic, usually a plastic or wooden board up to the chest level. Pathogen can be transmitted more easily due to the absence of a physical barrier and the short distance. Similarly, residents living in shared rooms should have a higher chance of infection than those living in single rooms. In an outbreak of *norovirus* gastroenteritis in a nursing home in Rotterdam, the attack rate was higher in single rooms (69%) than in four-bed rooms (53%). Among the residents who shared rooms, 33% became ill one or two days after the illness of a roommate, with RR: 5.02 (3.0 – 8.4)[18]. In our study, as a higher proportion of the subjects were living in shared fixed rooms (66%), of which about half were 2-4 person rooms and the other half were 5-8 person rooms, the degree of exposure to others is of similar rate among the partition

living and fixed room living residents. As a result, no conclusion can be draw about the relationship between the living room setting AG transmission.

Toilet & Isolation room

The resident to toilet seat ratio had a great different across the elderly homes. It is believed that homes with a lower ratio are at higher risk for infection and spread of pathogens. On the other hand, the non-outbreak homes had a more frequent routine cleaning practice. Concerning the isolation room, the suggested bed to resident ratio is 1:100 [139]. In our study, 3 homes (8.8 %) did not meet this requirement. Some elderly homes adopted the 'original room isolation policy' . Instead of sending the ill residents to the IR, they would send the healthy resident out of the room. This policy would be adopted especially during outbreaks involving a large number of ill residents. In our data, not many (34%) of the AG residents were isolated. A higher % (39%) of the residents from outbreaks were isolated than the residents from sporadic cases (28.6%). As suggested in the ordinance guideline, ill residents were temporarily isolated if they were suspected of having contracted a communicable disease[139]. This was decided by the ICO, who would judge whether the AG resident's illness was of the communicable type or not. To be safe, AG residents with sufficient severity in AG symptoms, for example, with . 3 diarrhoeas, or additional with other symptoms like vomit and stomach ache should be isolated. OHs had better IR facilities than NOHs in general. As the rate of admission into IRs was not high, IR facilities may not have a great effect on the infection c ontrol measure.

Ventilation

If AG is not an air-borne disease, ventilation should not be a major concern regarding infection control measure s. However, debate continues as to whether AG pathogens are spread via air-borne transmission or not. Data on ventilation in our study served as a reference to evaluate the environmental conditions in the elderly homes in general. Among the recruited homes, the ventilation system did not differ significantly among the outbreak and non-outbreak homes. Almost all (n=33) of the elderly homes had split type air conditioning systems and extractor fans, and all of them had electric fans in the bed rooms, either ceiling fans or table top fans. None of the non-outbreak homes used air fresheners but 75% (n=6) of the outbreak homes did. They were located in the public areas, isolation rooms and washrooms. We were unable to determine if the air fresheners had an effect on the spread of AG. No known mechanism supports such a phenomenon, so this may be a coincidence. As we did not investigate the activated percentage of air freshener, we cannot confirm whether the elderly homes used the air fresheners during outbreaks.

Infection control measures and policy

Infection control measures and policy are important to prevent the spread of AG by blocking the person-to-person transmission route. Inadequate infection control measures have been identified in many studies on the causes of outbreaks. In a *norovirus*-like outbreak that occurred in three institutions in Canberra, Australia, an outbreak started in an aged care institution just after it received a AG resident from another aged care institution which was having an AG outbreak[61]. This

revealed a deficiency in infection control measures to isolate the AG resident. The same study also identified several cases where person-to-person transmission could have occurred. The staff who cared for the first AG resident, cleaning up the vomit and diarrhoea, became ill 2 days later. The illness was further transmitted to the ambulance officer 2 days after an infected resident vomited in the ambulance on the way to the hospital. Inferior infection control policies, including the lack of protective apparel or improper use and lack of policy for cleaning shower chairs between bathing each of the residents were cited in this chain AG outbreak.

In our study, among the 24 outbreaks reported, the outbreak duration ranged from 1 to 13 days, with 67% ranged from 3 to 7 days. The duration is counted from the first case notification to the last case reported. Only one outbreak (in January, 2009) had a duration of one day. It was a confirmed *norovirus* outbreak involving 5 residents in an elderly home with 38 residents living on two floors. In this outbreak, all ill residents were living in a single partition arrangement on the same floor. Two males were clustered in the partition next to each other and three females were clustered together in another area, with a wall separation with the infected males. The infected male partitions were close to the common area while the infected female partitions were near to the toilet. They all claimed they had the same onset day without suspected source. If there were no unreported cases and the infection control measures were reported truthfully, this elderly home was successful in controlling the outbreak. Among the cases, they had diarrhoea, ranging from 0 to 6 times and vomiting, ranging from 2 to 5 times. They all claimed they did not

contaminate any public area, as well as personal use items, such as clothes and bed linens. They were all send to the hospital AED immediately and recovered within 2 days. None of them were isolated. Isolation could not be enforced in this outbreak as there was only one bed in the isolation room. 'Original room separation' could not be made possible as this elderly home did not have individual living rooms. Extra disinfection procedures targeted to this outbreak was not investigated.

At the other end of the scale, the outbreak with the longest duration (13 days) occurred in a large elderly home with 140 residents living on two floors during December, 2009. This outbreak involved 6 residents. The six residents were located in six different, shared rooms, with 4-7 residents in each room. They reported no contact with people with AG before becoming ill. Their symptoms were relatively mild. Five of them sought medical consultation and all six recovered within a few days (1-5 days). Three had been out of the home in the 7 days before illness, to the park, a Chinese restaurant and a clinic. The first case had diarrhoea 3 times in the most severe days but no vomiting. The resident reported the contaminants were cleaned up immediately by members of staff. No common source was identified and no samples were submitted for laboratory testing. None of the 6 victims were sent to IR, mainly because of the mild symptoms.

Overall, a higher percentage (40%) of the outbreak cases was sent to the isolation room than the non-outbreak cases (30%). About half (47%) of the elderly homes claimed they would send the AG resident to IR based on the severity of

illness. The 24 outbreaks in our study could be considered as small outbreaks with low attack rates (1.4 -15.8%). This may explain the low isolation rate. Restricting the AG residents from public areas is important to prevent the spread of pathogens. We observed that 5 homes (15%) did not have such policy and some homes had to share toilet and bathroom as there was no washroom in the isolation rooms. Elderly homes should take extra care to implement the policy of complete isolation and to prevent pathogens spreading by all other possible infectious routes, such as shared utensils and bathroom sharing. Besides, the dining arrangement may be a potential risk factor as residents had a close contact and may get a higher chance of infection by person-to-person transmission. In our study, no direct question in this area was collectd but information on the contact with AG residents by any route was obtained. Results showed no significant difference was found between the cases and the controls. Infection control policy on isolation from dining area was collected. Almost none of the elderly home (except one) would allow the AG residents to have meal in the dining area.

Among the 69 AG cases in which their excreta had contaminated clothes or public areas, 32 were from sporadic cases and 37 were from outbreak cases. Disinfection procedures were not enforced immediately in some of the outbreak homes (11%) and the non-outbreak homes (3%). The disinfection would be completed within 10 minutes in outbreak homes and 5 minutes in non-outbreak homes for those homes that did not have an immediate action. Previous studies have demonstrated that disinfection efficiency is critical in the control of AG outbreak. In

a *norovirus* outbreak that occurred in a hospital and an elderly home in Austria, 2004, control measures were implemented only after virological confirmation in the hospital. In the elderly home, the control measures were implemented immediately without virological confirmation. Sixteen cases had already occurred in the hospital by the time of disinfection while the outbreak terminated in the elderly home after a further 4 people were infected. Early response to the unusual increase in AG residents is effective to control the spread of pathogens [221].

Routine hygienic practice and food handling practice

Good routine hygiene practice is the first defence against all infectious diseases, including AG. Precautions and guidelines on routine hygienic practice have been imposed by the Department of Health, HKSAR. The guidelines cover choice of disinfectant, disposal of waste, disinfection measures in the elderly home, especially for frequently touched surfaces, floors, toilets, bathrooms and kitchen [139]. In our study, the routine hygienic practice adopted in the elderly homes was satisfactory. All elderly homes had routine hygienic practice using 1:99 diluted household bleach (5.25% bleach) daily. The majority of the homes clean ed the floors, furniture, waste bins, bathrooms, and frequently used objects at least once per day, which is considered to be adequate. Bed sheets were replaced once per week and duvet covers were replaced once per month. In comparison, some of the non -outbreak homes had a more frequent cleaning practice than the outbreak homes. However, we cannot conclude that the frequency of routine cleaning practice is a risk factor of AG due to the small sample size and the data concluded from descriptive analysis. The

guidelines from DH do not offer concrete suggestions on the frequency of cleaning, but stipulate the recommended bleach dilution and the cleaning procedures in detail. It is suggested that the floors are cleaned with bleach, rinsed thoroughly with water and then dried. Places contaminated with secretions or excreta should be disinfected with 1:49 diluted bleach and left for 15-30 minutes before being rinsed with water. This action enables sufficient time for disinfection. 'Guidelines on prevention of communicable diseases in residential care homes for the elderly' from DH states the recommended method to disinfecting a commode, stating that 'A commode should be washed with detergent and water after eash use and regularly'. However, we noticed that not all the elderly homes cleaned the commodes after every use, with over 30% (n=11) of of the toilets being cleaned only once per day. This is unacceptable as the exposed excreta should be cleaned immediately to prevent the spread of pathogens, even with the presence of lids.

In our study, no suspect food samples were collected for pathogen identification and the risk of food-borne infection from home-prepared food was considered to be low. This is because a larger outbreak should be expected to result if the outbreak is due to problematic food items [65]. Data on food handling practice and kitchen hygiene conditions served as information to evaluate the general state of food hygiene. Similar findings were recorded between outbreak and non-outbreak homes. The chefs were knowledgeable in the treatment of wounds, storage of uncooked food, using separate knife and chop board for cooked and raw food, and defrosting method. In an outbreak of Escherichia coli O157 gastroenteritis in an elderly home in the

West Midlands, UK. A potential for cross contamination was observed when the same preparatory surface was used for handling raw and cooked foods [71]. Although the kitchen workers in the UK had good hand washing practice, less than half of them wore masks during cooking. Previous studies have reported that chefs could be the source of AG outbreaks[66, 222, 223]. There is no definitive proof of transmission from the respiratory tract, but it is known that mask wearing is able to prevent mouth droplet transmission to the food. The relationship between individual hygienic factors and institutional factors was analyzed in this study. No significant result was found. The conclusion reached, therefore, was that the poor hand wash practice after using the toilet that increased the risk of AG did not interact with institutional factors. However, the results might not reach sufficient statistical power as this study collected limited institutional data. Also, the same institutional factors applied to both cases and controls as they were matched on elderly homes, this was the main limitation.

8.6 Other potential risk factors of AG

Consumption of risky food groups

Risk factors other than hygienic practice, such as consumption of risky food groups like shellfish, oysters, eggs leftover food and delivery food over the 7 days preceding the interview / from the AG onset day in relation to AG, were studied in this project. How well cooked the food was, was also investigated. No resident consumed raw food and only 1% and 6.2% of the residents consumed leftover food

and delivery food from their friends and parents respectively. No leftover and delivery food were provided from the elderly homes. No significant risk factor was found. Among the 12.1% (n=17) who believed their AG was caused by food-borne infection, 10 of the residents came from outbreak cases. However, the food was not suspected in other residents from the same outbreak. This indicates the risk of food-borne infection was low. Unlike elderly who consume raw food (for example, salads) regularly in Western countries [122], Chinese elderly tend to consume cooked food. Hong Kong elderly homes provide cooked dishes in general. So the chance of getting AG from uncooked food is low.

Eating habits and nutritional status

Nutritional status is considered an AG risk factor as it is closely related with immunity [120, 126, 224]. Poor immunity is closely related with increased incidence of infection including AG [120, 122]. Major food groups consumption was investigated in our study by a mini food frequency questionnaire (FFQ) including the food groups of fruit, vegetables, milk or milk products, soymilk or soymilk products, red meat, white meat, fish and eggs. The overall health status was measured by BMI and the self nutritional evaluation. No particular consumption or avoidance of food items was associated with AG. 'Self-nutrition evaluation as not enough' indicated a significant association with AG. A correlation between poor nutrition and AG can be concluded in our study if the evaluation reflected the real nutritional status of the elderly residents interviewed. However, information bias, reporting an inferior health condition, might occur if the residents were ill during interviews.

Medical history and age-related factors

In our study, 'having Alzheimer's' and 'Simplified Bathel Index (SBI) scored below <15' were found to be significant risk factors in the multiple logistic regression. This is in consistent with data published in other countries. Medical history of dementia was found to be a risk factor in several AG studies. As concluded by Wu [21] and Sakon [19], faecal incontinence, dementia, and immobility are common conditions that may facilitate extensive contamination of the environment with faecal pathogens. Difficulty in controlling sanitation in a group living environment for the elderly with dementia may be one of the causes in AG outbreak. In a chain *norovirus* outbreak reported in the Tel-Aviv district in Israel, most of the victims were bedridden [72]. In another *norovirus* outbreak in a geriatric long-term-care facility in Washington, residents requiring nursing assistance or who were bedridden were 3.5 times more likely to meet the case definition than those who were less physically impaired [46].

A person's immune system functioning decreases with age, so people have decreased resistance to pathogens as they age [121, 225-228]. Age-related immune system function weakening may diminish the ability to resist food-borne pathogens in the elderly [122]. Secondly, stomach acid production declines with age, allowing more ingested pathogens to enter the gastro-intestinal tract. In our study, age factor is adjusted in the study design by recruiting case-matched control groups within a 5-year range.

Antibiotics overdose in elderly homes has been reported worldwide[229-231], and may account for at least 40% of prescribed medication in elderly homes[121, 126]. In the past, antibiotic treatment in elderly homes was often initiated in the absence of a physician's examination[232, 233]. Antibiotics were often prescribed for infections in which antibiotics are not considered to be effective [234]. This inappropriate usage leads to the potential for emergence of resistant microorganism and negative effect on immune response [121, 235]. Consumption of antibiotics was correlated with increased colonization and subsequent symptomatic infection for *Clostridium difficile* [236-238] However, history of antibiotic consumption was not found to be a significant factor for AG in our study. This may be due to the small sample size as less than 3% of the residents had a history of antibiotic consumption, and their consumption duration was short, with 70% taking antibiotic treatment for under one week.

Person-to-person infection outside elderly home

'Hospitalization in past month' was found to be a significant risk factor for AG, and 'away from institution during past week' was also identified as significant risk factor in the analysis with 75 Alzheimer's residents excluded. Thus hospital-acquired infection is a potential source of AG. It is also possible that elderly with AG might infect other hospitalized elderly patients. Inter-institutional cross infection has been noted in Austria, with AG transmission from an elderly home to a hospital[20]. Residents may also get infected from the community through person-

to-person transmission if they go to the public areas [239]. Staff from elderly homes should take extra care of residents who were transferred back from hospital. Isolation and medical consultation should be enforced if AG symptoms are identified from these residents.

8.7 Limitation and strength

Limitation

In general people who do not respond in a study often differ from those who do in regard to many demographic, socioeconomic, cultural, life-style, medical characteristics, and even the hypothesis characteristics under testing[240]. Convenience sampling was adopted in this study; therefore, subject homes may have better hygienic practice and environment than non-response homes. As a result, this selection bias may overestimate the standards of the hygienic practice and the hygienic environment of the elderly homes. On the other hand, it may underestimate the number of AG cases in the population. Sampled homes in this study are skewed to the Sha Tin district and to the small scale private homes. The 14 subject homes that did not have a case report throughout the study were composed of 13 private homes and 1 subvented home.Since private homes tend to have a higher underreporting rate [5] than subvented homes, it is possible that some outbreak homes may be misclassified as non-outbreak homes in this study. This may lead to incorrect interpretation of the descriptive institutional hygiene analysis, as the results were based on the comparison of the instituitional hygienic practice among the outbreak and non-outbreak homes. Concerning the personal risk factor analysis, the

transmission route of sporadic, index and secondary cases might be different and should be analyzed separately. However, due to the small sample size and small scale of the outbreak cases, no stratified analysis was run.

AG prevalence calculated from community-based studies based on statutory notifications or laboratory reporting is a gross underestimation [241, 242]. In a surveillance study on acute infectious intestinal disease in England, for every case of *norovirus* infection reported to national surveillance, there were 1,562 others estimated in the community[44]. In our study, 14 homes did not have case reports throughout the data collection period, although we tried various methods to obtain case notification. Comparing the surveillance programme administered by CHP, HKSAR Government, the incidences ranged between 0.05-0.68 residents per 1,000 residents per day (Fig. 2.1). This is equivalent to our study with 0.02-0.19 per 1,000 resident per day, approximately 4 times lower, compared with CHP data. Information from CHP was obtained from approximately 50 voluntary elderly homes, including both private and subvented homes distributed in Hong Kong Island, Kowloon and the New Territories, with the inclusion criterion of any acute diarrhoea. The discrepancy of the incidence rates between CHP data and our study might be due to differences in case definitions and sampling distribution, as CHP adopted any acute diarrhoea as cases while cases had to experience 3 diarrho eas or any vomiting within 24-hour period from a non-infectios cause in our study. Cases identified in CHP might not be included as cases in our study. However, there may also be

underreporting of cases. This not only lengthens the data collection period, but also underestimates the disease burden of the undisclosed AG cases.

Secondly, during the control selection, we clearly instructed and explained the steps to the elderly home staff. However, we observed that residents in the control group were more physically active, although without significant difference. The principle of random sampling is important in epidemiological study [243]. Sampling bias in control selection may distort the odds ratios and consequently lead to wrong interpretation regarding the associations of exposure and disease. For example, dementia was found to be a risk factor in our study. However, if the controls were not randomly selected but skewed to the more physically active residents, dementia would be a pseudo risk factor. Also, 17 crossover pairs from cases to controls or vice versa during the study period may have biased the study results. We compared these two sets of data and found that their results were similar.

Thirdly, our data are subject to information bias. We relied heavily on case identification by both the CGAT nurses and the staff of the elderly homes. Misclassification bias might be the result if they neglected the case definition. We tried to minimize the bias by reconfirmation of the symptoms, and the medical history of the residents. Recall bias is another common problem in case-control studies [244]. This might be a more serious problem in our study as short term memory is common in the elderly. We tried to minimize the error by confirming suspect

answers with home staff and adopted a proxy respondent if necessary. On the other hand, reporting bias might also result from proxy interviews as the proxies might not have accurate information about the history and personal practices and behaviors such as hand washing practice of the residents. A higher rate of proxy interview was conducted among the cases than the controls in this study. We tried to minimize the error by collecting information from the residents' medical files. For eating and living practice information, we redirected the questions to the specific caregivers.

Lastly, multilevel modelling can better identify AG risk factors at different levels[245], for example, among private and subvented levels, sporadic and outbreak levels, district level, size of the elderly homes, and index case and secondary case levels. However, a sufficient sample size is necessary to reach statistical power. In multilevel modelling, the sample size at the highest level is the main limiting characteristic of the study design [246247]. Using a rough estimation, and a rule of thumb of 30 samples for a representative, normal distributed population [248], an example of an estimated sample size was calculated to be 1020 (34 eldely homes x 30) residents for the investigation of home level, which far exceed our collected samples (420 residents). As a result, multilevel modelling was not used in this study.

Strengths

This study has a number of strengths. Firstly, the surveillance programme from CHP only recorded the incidence of AG. It does not capture information on risk factors and disease burden. This project supplemented such information by providing

data on individual hygienic risk factors analysis and the disease burden including the medication and economic costs. Recommendations and policy formulation can be addressed, based on the study results. Although existing resources and legislation have been imposed targeting the prevention of AG, AG outbreak in elderly homes still persists every year. Our project investigated this phenomenon and attempted to identify the significant poor hygiene risk factors causing AG.

Secondly, potential risk factors other than hygiene factors were adjusted in the analysis level. It should be noted that our analysis included the consumption of risky food groups, the daily life activities that involved risk in AG pathogen exposure and the medical history. The control group was sex and age matched in the data collection level. Thirdly, we adopted clear inclusion criteria for case and outbreak identification. This allows easy differentiation over the case selection, as AG is composed of a series of symptoms, without a clear cut clinical definition [1].

8.8 Recommendations and future direction

Recommendations

This study has identified problems in some of the elderly homes in terms of their routine hygienic practice and infection control measures. Improvement on these practices is important to reduce AG cases and outbreaks. Besides improving staff knowledge towards infection control, government should focus resources on monitoring the routine hygienic practice, for example, the hand wash practice and the disinfection practice, in order to maintain and improve hygiene standards.

Besides, staff of the elderly homes should strictly enforce the infection control policies. The recommendations below summarize the areas that can be improved.

1. Staffing The turnover rate of staff in elderly homes is high. This leads to the possibility of lower 'staff to resident' ratio. Overload staffing cannot perform a good hygiene practice. Moreover, some owners are also HWs. They are head counted into the ratio requirement but the amount of actual care they give cannot be controlled. This adds workload to the frontline staff. Routine checking over the presence of Infectioun Control Officers, and frontline staff are of importance to ensure adequate manpower to maintain a good hygienic environment in the elderly home.

2. Enforcement of hand washing practice Regular notice or workshops on hand hygiene should be enforced. In practice, intervention programme s, such as setting up a fixed hand wash time before meal time can compel and encourage residents to make hand washing habitual. Regular reminders of correct hand wash procedure and when the hands should be washed should also become routine.

3. Ensure adequate hand washing facilities The hand wash basin to resident ratio should be monitored. As some of the isolation rooms do not have individual toilet s, extra attention should be paid to providing a 'separate' public toilet and hand wash basin to the case resident. If the elderly home is of a small scale, frequent disinfection of the toilet, bathroom and hand wash basin is effective to prevent

person-to-person infection, as the washroom is a high risk place for pathogen spreading.

4. Enforcement in isolation practice Sending AG residents to an isolation room is adopted in most of the elderly homes. However, restriction over common areas and other public activities, such as dining together and daily activity gatherings is not fully implemented. Education on isolation practice should be stressed and promoted.

5. Seek medical consultation Our study revealed that many of the AG residents did not seek medial consultation, with some elderly homes even medicating residents without medical advice. The elderly home should report all cases and should seek a professional medical opinion if the symptoms persist. Early case identification can help to control the spread of pathogens. Besides, self management on AG infection should be enforced in those elderly homes with nursing support, as medical consultation may not add additional benefits to mild cases. Nurses can identify those cases that are self limiting and can give appropriate treatment in a safe way.

6. Monitoring of residents discharged from hospitals Residents discharged from hospitals is found to be a significant risk factor for AG infection. Extra attention should be paid to their health conditions. If residents are discharged from AG infection, close monitoring on their symptoms and advice on personal hygiene should be instituted to prevent person-to-peroson transmission.

7. Notification In case of outbreak, early notification to government parties can help to control the spread by external assistance. It is also important to keep a central record to track the source of the pathogen in case of chain outbreaks. The elderly homes should follow the guidelines and report any outbreak to the required organizations.

8. Maintain a good nutritional status Immunity is the first denfence against pathogens. 'Poor nutritional status' is identified as a significant risk factor for AG infection, although the assessment was self evaluated. Meal planning in elderly homes should provide a balanced diet to the residents. Residents with feeding difficulties or extra needs are at risk of nutritional deficit and should not be neglected.

9. Pay attention to dementia or physically inactive residents Residents with Dementia may not be able to express their illness and physically inactive residents may not be able to handle defecation by themselves. SBI scored <15 and Alzheimer's were found to be significant risk factors of AG in this study. Awareness on the hygienic practice and the AG symptoms of these groups of residents can help prevent infection and spread of AG.

10. Adopt good routine institutional cleaning practice In this study, the non-outbreak homes were found to have a more frequent rountine institutional cleaning

practice than the outbreak homes. Prevention is better than cure. A good rountine cleaning practice is important for AG prevention. Although elderly homes have guildelines and instructions on routine cleaning practice, the enforcement of these policies should be closely monitored.

Future direction

In this study, we identified the individual hygiene risk factors and the potential institutional characteristics on AG infection in elderly homes. However, this case-control study encountered some unavoidable limitations. A prospective cohort study may be a more appropriate design to investigate factors related to AG in Hong Kong elderly homes. For examples, reporting bias from proxy interviews can be reduced as interviews can be pre-arranged with the residents in a cohort study. Proxy interviews due to AG illness can be avoided. Also, a cohort study may improve the underreporting rate as case notification can be done on a regular basis. It can reduce the anxiety of staff aroused from an instant case report following immediate interviews in a case-control study. On the other hand, pathogen identification and investigation of the pathogen origin were not carried out. Information on AG staff, environmental swabs, and the possibility of asymptomatic control was not examined. In Hong Kong, few studies have been conducted to associate the possible linkage of AG outbreaks among elderly homes and other institutions, such as hospitals. Future study may focus on the phylogenetic comparison with AG cases in other localities, locally and institutionally. This helps us to better understand the epidemiology of the pathogen spread, such as tracing the source of the pathogen and the transmission route. Environmental swabs help to

identify the possible transmission objects. Immediate disinfection action can be applied to wipe out the source of pathogens. Identification of asymptomatic control can help us to better understand the possible unseen transmission route. Future study may also focus on an intervention programme on hand hygiene in elderly homes to validate the effectiveness of hand wash practice. Details on hand wash practice such as type of disinfectant, duration of hand wash and drying and frequency of hand-washing merit further investigation for their potential to reduce or increase risk in AG infection. Besides AG infection, studies can also investigate other common infectious disease in Hong Kong elderly homes such as upper respiratory tract infection and skin problems.

CHAPTER 9
CONCLUSION

Acute gastroenteritis (AG) is the most common infectious outbreak occurring in elderly homes. Although AG is a self-limiting disease, the corresponding social and economic cost can be extensive. Identification of the hygiene risk factors and monitoring of the infection control measures are important to reduce AG cases. Previous studies of many single outbreaks have found poor hand wash practice, close contact with AG patients, and inadequate infection control measures correlate with AG infection. The present case-control study aimed to identify the hygiene risk factors at both individual and institutional levels. Data on other risk factors were also recorded.

Individual hygienic risk factor of 'sometimes or never wash hands after toilet' was recorded as the most significant risk factor for AG infection, while such significance was not found in hand wash practice before meal s. Hand wash duration and agent used for hand washing, changing of clothes and bathing behaviours were not found to be significant risk factors for AG infection. In terms of institutional hygienic characteristics, a higher percentage of the NOHs had a more frequent routine cleaning practice than the OHs, while the NOHs and OHs shared other similar hygienic practices and conditions such as the method and agent used for disinfection, the environmental hygienic conditions, and hygiene in food preparation and handling.

Four other individual susceptibility factors were identified as significant in this study: 'self-nutrition evaluation as not enough', 'having Alzheimer's, 'Simplified Barthel Index scored <15' and 'hospitalization within a month'. This may indicate that poor immunity, immobility and cross-institution infection through person-to-person transmission are the other possible cause of AG infection. Other institution-based characteristics of lower health worker to resident ratio were recorded in OHs than NOHs. This shows that adequate manpower may be one of the important factors for AG prevention. No significant difference in other institutional characteristic was identified as favouring AG infection.

The disease burden of AG infection in Hong Kong elderly homes was relatively mild compared with other age groups in which the indirect costs may be huge. The percentage of case residents that experienced diarrhoea was double the percentage that experienced vomiting. A large difference was recorded in the total number of ill days. The direct medical costs paid by the residents were relatively low and the indirect costs included the time lost for case residents, staff, family members and friends, and cost for staff to accompany the resident to visit the doctor.

The present study helped us better understand the epidemiological characteristics of acute gastroenteritis (AG) in elderly homes in Hong Kong. This study will also be critical in providing important data for recommendations and policy formulation towards AG prevention. Future direction focus on phylogenetic studies, infection of staff, and environmental swab investigation will expand the

scope of the present study. More epidemiological data on the aetiology and route of transmission should be collected. Future studies of intervention programmes on hand hygiene in elderly homes are required to validate the effectiveness of hand wash practice.

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APPENDIX

香港中文大學

公共衞生學院及基層醫療學院

香港老人院急性腸胃炎研究

香港中文大學醫學院 • 何鴻燊防治傳染病研究中心
Stanley Ho Centre for Emerging Infectious Diseases
Faculty of Medicine
The Chinese University of Hong Kong

香港老人院急性腸胃炎研究 --- 諾沃克病毒感染同意書

背景:

近年急性腸胃炎在本港安老院院舍爆發一直被受關注，根據衛生防護中心數據顯示，於05 至 06 年間，諾沃克病毒在院舍的爆發個案由 42 宗上升至 265 宗，所影響的人數由 643 人增加至 2806 人。有見及此，香港中文大學醫學院公共衛生學院何鴻燊防治傳染病研究中心將會於 07 年 10 月至 08 年 12 月期間，於新界東之私營及資助安老院進行研究。

研究目的:

本研究旨在對個人或集體急性腸胃炎感染之風險因素進行分析，研究方法主要是以問卷形式進行，問卷內容主要包括閣下之個人衛生、生活習慣和病歷。閣下的參與有助我們制定防疫目標和其他公共衛生計劃。

獲邀受訪:

閣下已獲邀成爲本研究之受訪者，訪問時間約爲 20 分鐘。本問卷內容並不汲及任何敏感問題，並不會對閣下構成任何生理或心理上的不適。如院友因精神或生理原因未能自行作答，問卷可交由院友之監護人或院舍職員作答，研究人員必須事先徵求院友之監護人同意，方可邀請院舍職員進行代答。

受訪者權利

1. 成功完成問卷的受訪者可獲贈五十元面額的超級市場現金券
2. 如閣下於訪問期間患上急性腸胃炎(病徵包括三次或以上腹瀉 / 兩次或以上嘔吐) ，本研究會替閣下之糞便樣本作免費化驗服務，以查證病友的病原體是否與諾沃克病毒有關，化驗報告會隨後送交安老院。
3. 閣下可於訪問中途因任何理由而拒絕回答研究人員部份或餘下的問題
4. 本研究所獲得之資料將會絕對保密及只作統計分析用途

聯絡方法

如對本研究有任何查詢，歡迎至電 2145 8931 與馮佩君小姐聯絡。

本人已細心閱讀此份同意書，並清楚明白及同意以上所有細則:

院友 / 監護人*簽署: _____

院友 / 監護人*姓名: _____

日期: _____

(* 請刪去不適用者)

Screened by:	Final checker:	Data Input 1:	Data Input 2 :	Serial Number:

香港老人院急性腸胃炎研究 --- 諾沃克病毒感染

Part I 訪問院友

I. 訪問員及被訪者資料

1. 老人院名稱 / 編號:	_____	HOMENAME HOMENO
2. 受訪者編號 (case / control):	_____	RESPNO
3. 姓名:	_____	
4. 性別:	_____	SEX
5. 出生日期 (自述):	_____ 身份証: _____	DOB IDCARD
6. 年齡:	_____ 身高: _____ 體重: _____	AGE HEIGHT WEIGHT
7. 訪問員姓名 (編號)	_____	INTVNO
8. 訪問日期:	_____	INTDATE
9. 樣本收集日期:	_____	SAMDATE
10. 開始時間:	_____	START
11. 結束時間:	_____	END
12. 訪問需時:	_____	TIME
13. 訪問地點:	☐ 1 老人院 ☐ 2 醫院	PLACE
14. 提供資料者	☐ 1 本人 ☐ 2 代理受訪者 ☐ 3 本人 - 代理受訪者	ANSWER
a. 代理受訪者與受訪者關係.	☐ 1 院舍職員 ☐ 2 其他 . _____	RELATION
b. 採用代理受訪者原因:	☐ 1 神智不清 ☐ 2 健康問題 ☐ 3 受訪者拒絕受訪 ☐ 4 其他: _____	REASONP

II. 人口特徵

1. 你喺香港總共住咗幾多年? _____ 年 LIVEHK
2. 你嘅婚姻狀況係 MARITAL
   - ☐ 1 單身
   - ☐ 2 已婚
   - ☐ 3 喪偶
   - ☐ 4 離婚 / 分居
   - ☐ 5 其他: _____
3. 你嘅教育程度係 EDUCTN
   - ☐ 1 沒有受教育
   - ☐ 2 卜卜齋
   - ☐ 3 小學
   - ☐ 4 中學
   - ☐ 5 大專或以上
4. 你有冇宗教信仰? RELIGION
   - ☐ 1 冇
   - ☐ 2 佛教
   - ☐ 3 道教
   - ☐ 4 天主教
   - ☐ 5 基督教
   - ☐ 6 中國民間信仰
   - ☐ 7 拜祖先
   - ☐ 8 其他
5. a. 你後生有冇做工? YOJOB
   - ☐ 1 有
   - ☐ 2 冇 (跳下題)

   b. 你退休之前邊一份工做得最耐? JOB
   - ☐ 1 經理及行政人員
   - ☐ 2 專業人員
   - ☐ 3 輔助專業人員
   - ☐ 4 文員
   - ☐ 5 服務工作及商店銷售人員
   - ☐ 6 工藝及有關人員
   - ☐ 7 機台及機器操作員及裝配員
   - ☐ 8 非技術工人(如家務助理)
   - ☐ 9 漁農業熟練工人
   - ☐ 10 其他，請註明_____
6. 你退咗休幾多年? _____ 年 RETIYEAR
7. 你而家主要嘅收入來源係 FINANCE
   - ☐ 1 家人
   - ☐ 2 退休金
   - ☐ 3 政府
   - ☐ 4 冇

訪問員紀錄:

8. 該層之總院友人數: _____ FLOORNO
9. 該院友所住的房間類型: ☐ 1 獨立房間 ☐ 2 固定圍板 人數:_____ ROOMTYPE1

RESIDNO

III. 衛生問題

1. 請問你去完廁所有冇洗手? ☐ 1 每次都有 ☐ 2 間中有 ☐ 3 完全冇 ☐ 4 不適用. 不能自己去廁所, 用尿片 — HANDTO

2 請問你食飯之前有冇洗手? ☐ 1 每次都有 ☐ 2 間中有 ☐ 3 完全冇 ☐ 4 不適用. 用食喉 ☐ 5 抹手 — HANDMEAL

3. 請問你洗手(抹手)時:

a. 有冇用清潔劑? ☐ 1 冇 ☐ 2 梘/梘液 ☐ 3 酒精啫喱 ☐ 4 其他. 請註名:_____ ☐ 5 消毒毛巾 — SOAP

b. 會洗幾耐? ☐ 1 少於 5 秒 ☐ 2 5 至 9 秒 ☐ 3 10 至 14 秒 ☐ 4 15 至 19 秒 ☐ 5 20 秒或更多 — WASHTIME

c 會唔會擦下隻手? ☐ 1 會 ☐ 2 間中 ☐ 3 唔會 — RUBHAND

4 你有冇同其他院友共用毛巾? 包括抹手巾 ☐ 1 有 ☐ 2 間中 ☐ 3 冇 — SHARETOW

5. 請問你幾耐沖一次涼? ☐ 1 每日多於 1 次 ☐ 2 每日一次 ☐ 3 隔日一次 ☐ 4 每星期 2 次 ☐ 5 每星期 1 次 ☐ 6 其他. 請註明 _____ — BATHFREQ

6. 請問你幾耐換一次衫? ☐ 1 每日多於 1 次 ☐ 2 每日一次 ☐ 3 隔日 1 次 ☐ 4 每星期 2 次 ☐ 5 每星期 1 次 ☐ 6 其他. 請註明 _____ — CLTHFREQ

IV.飲食、生活習慣及病歷

飲食習慣

1.喺過去7日，你<受訪者>有冇進食以下種類嘅食物?

a. 剩餘食物，例如「隔夜餸」			☐ 1 有	☐ 2 冇	LEFTOVER
b. 外賣或到會食物，例如外賣飯盒、「斬料」、送飯			☐ 1 有	☐ 2 冇	TAKAWAY
c. 雞蛋	☐ 1 全熟	☐ 2 半生熟	☐ 3 生	☐ 4 冇	EGG
d. 蠔	☐ 1 全熟	☐ 2 半生熟	☐ 3 生	☐ 4 冇	OYSTER
e. 其他貝介類海產，如蝦、蟹、蚌	☐ 1 全熟	☐ 2 半生熟	☐ 3 生	☐ 4 冇	SHELFISH

2. 你有幾經常食以下種類嘅食物?

	每日多於3次	每日2-3次	每日1次	每星期2-6次	每星期1次	1個月2-3次	1個月1次	從不	
新鮮水果	☐ 8	☐ 7	☐ 6	☐ 5	☐ 4	☐ 3	☐ 2	☐ 1	FRUIT
新鮮蔬菜	☐	☐	☐	☐	☐	☐	☐	☐	VEG
奶或奶類製品	☐	☐	☐	☐	☐	☐	☐	☐	MILK
大豆或大豆類製品	☐	☐	☐	☐	☐	☐	☐	☐	SOY
紅肉	☐	☐	☐	☐	☐	☐	☐	☐	REDMEAT
白肉	☐	☐	☐	☐	☐	☐	☐	☐	WHITMEAT
魚肉	☐	☐	☐	☐	☐	☐	☐	☐	FISH
雞蛋	☐	☐	☐	☐	☐	☐	☐	☐	EGG1

3. 你覺得自己夠唔夠營養? ☐ 1 夠 ☐ 2 唔夠 SELFNUT

生活習慣

1. 你有冇做運動嘅習慣? ☐ 1 有 ☐ 2 冇 (跳卜題) EXERICSE

a. 咁你幾耐做一次運動? EXFREQ
- ☐ 6 一日多於 1 次
- ☐ 5 一日 1 次
- ☐ 4 一星期 2-6 次
- ☐ 3 一星期 1 次
- ☐ 2 一個月 2-3 次
- ☐ 1 一個月 1 次

b. 咁每次做運動你會做幾耐? EXTIME
- ☐ 1 少於 15 分鐘
- ☐ 2 15 至 29 分鐘
- ☐ 3 30 至 44 分鐘
- ☐ 4 45 至 1 小時
- ☐ 5 多於 1 小時

2. 你而家有冇食煙? ☐ 1 有 (跳去 c) ☐ 2 冇 SMOKE

a. 咁你以前有冇食煙? ☐ 1 有 ☐ 2 冇 (跳下題) PASTSMOK

b. 咁你戒咗煙幾多年? _____ 年 GIVEUPSM

c. 咁你食咗幾多年煙? _____ 年 SMOKEYR

d. 咁你(而家/以前)每日食幾多支煙? _____ 支 SMOKFREQ

3. 喺過去 28 日內，你有冇入過醫院?	☐ 1 有 ☐ 2 冇	HOSPITAL
4a. 喺過去 7 日內，你有冇離開過老人院?	☐ 1 有 ☐ 2 冇 (跳下題)	OUTHOME
b. 你去咗邊個地方?	_____	OHPLACE
5a. 喺過去 7 日內，你有冇離開香港?	☐ 1 有 ☐ 2 冇 (跳下題)	OUTHK
b. 你去咗邊個地方?	_____	OHKPLACE
6a. 喺過去 7 日內，你有冇接觸過患有急性腸胃炎嘅人?	☐ 1 有 ☐ 2 冇 (跳下題)	CONTACTILI
b. 咁佢地係你嘅咩 ☐ 1 照顧員 ☐ 2 同房院友 ☐ 3 不同房院友 ☐ 4 探病家人 ☐ 5 探病朋友 ☐ 6 鄰居		WHOILL
7a. 最近有冇人嚟探過你?	☐ 1 有 ☐ 2 冇 (跳下題)	VISIT
b. 係幾多日之前?	_____ 日	VISITDATE
c. 佢地有冇留低食物俾你?	☐ 1 有 ☐ 2 冇 (跳下題)	LEFTFOOD
d 係咩食物?	_____	FOOD
e. 你點樣貯存? ☐ 1 放入床頭櫃內 ☐ 2 放在床頭櫃上 ☐ 3 放入雪櫃 ☐ 4 其他		STOREFOOD
f. 你隔咗最長時間幾多日仲有食?	_____ 日	EATFOOD

病歷

1 有冇醫生曾經話過你有以下找所講嘅慢性疾病呀?

a. 腦血管病(中風)	☐ 1 有	☐ 2 冇	ILL a
b 柏金遜病症	☐ 1 有	☐ 2 冇	ILL b
c. 心臟病 (包括冠心病. 心力衰竭, 心率不齊)	☐ 1 有	☐ 2 冇	ILL c
d. 高血壓	☐ 1 有	☐ 2 冇	ILL d
e.慢性支氣管炎或肺氣腫	☐ 1 有	☐ 2 冇	ILL e
f 哮喘	☐ 1 有	☐ 2 冇	ILL f
g.肺結核病	☐ 1 有	☐ 2 冇	ILL g
h.消化道潰瘍	☐ 1 有	☐ 2 冇	ILL h
i 糖尿病	☐ 1 有	☐ 2 冇	ILL i
j 關節炎	☐ 1 有	☐ 2 冇	ILL j
k. 陳舊性骨折(舊嘅骨折)	☐ 1 有	☐ 2 冇	ILL k
l 老人痴呆症	☐ 1 有	☐ 2 冇	ILL l
m 精神病 (老人痴呆症除外)	☐ 1 有	☐ 2 冇	ILL m
n. 癌症	☐ 1 有	☐ 2 冇	ILL n

2a. 你現在有冇服用任何藥物? ☐ 1 有, 藥名_____ ☐ 2 冇		DRUG
		DRUGNAME1
b. 你有冇曾經有 星期或以上服用過抗生素? ☐ 1 有 ☐ 2 冇 (跳下題)		ANTIBIO
c 咁你食抗生素食咗幾耐?	_____星期 / 月 / 年	DURANTIB
d. 咁你而家仲有冇食緊抗生素? ☐ 1 有 ☐ 2 冇		NOWANTIB

V.急性腸胃炎之病徵、求診與治療、社會及經濟影響

A. 病徵

1. 喺過去 7 日，你有冇試過: DIARRHEA

a. 腹瀉，即稀爛或水狀大便 ☐ 1 有日期:_____ ☐ 2 冇 (跳去 b) DIARDATE

i 咁喺最嚴重嗰一日，你喺24小時內一共腹瀉咗幾多次? _____次 (≥3?) DIARTIME

ii. 咁你有冇腹瀉帶血? 如果有，持續咗幾多日? ☐ 1 有. ____ 日 ☐ 2冇 BLODIA BLODAY

iii. 咁喺最嚴重的一日，你喺24小時內一共有幾多次腹瀉帶血? _____次 BLOTIME

iv. 咁你痾咗落邊道 ? 有冇整污其他嘢? ☐ 1 廁所 ☐ 2 衣服 ☐ 3 地下 ☐ 4 床單 ☐ 5 被袋 ☐ 6 傢俬 ☐ 7 其他物件 ☐ 8 沒有. 痾在廁所或尿片 DIARPLACE

v 咁院舍職員幾時黎幫你清理? ☐ 1 即刻 ☐ 2 少於 5 分鐘 ☐ 3 5 至 9 分鐘 ☐ 4 10 至 14 分鐘 ☐ 5 15 至 29 分鐘 ☐ 6 30 分鐘或更多 DIARCLEN

b. 嘔吐 ☐ 1 有 日期._____ ☐ 2 冇 (跳去 c) VOMIT VOMIDATE

(如沒有腹瀉或嘔吐. 院友爲研究參考組別. ~問卷完 ~)

i. 咁喺最嚴重嗰一日，你喺 24 小時內一共嘔咗幾多次? _____次 VOMTIME

ii. 咁你係嘔咗落邊道 ? 有冇整污其他嘢? ☐ 1 嘔吐袋 ☐ 2 衣服 ☐ 3 地下 ☐ 4 床單 ☐ 5 被袋 ☐ 6 傢俬 ☐ 7 其他物件 ☐ 8 沒有.嘔在洗濕槽或膠袋內 VOMPLACE

iii. 咁院舍職員幾時黎幫你清理? ☐ 1 即刻 ☐ 2 少於 5 分鐘 ☐ 3 5 至 9 分鐘 ☐ 4 10 至 14 分鐘 ☐ 5 15 至 29 分鐘 ☐ 6 30 分鐘或更多 VOMCLEN

2 你有冇因是次腸胃炎被送入隔離室? ☐ 1 有 ☐ 2 冇 ISOROOM

3. 喺你呢近一段痾嘔期間，你仲有冇咩嘢唔舒服?

a. 發燒	☐ 1 有	☐ 2 冇	SYM a
b 壯痛	☐ 1 有	☐ 2 冇	SYM b
c. 頭痛	☐ 1 有	☐ 2 冇	SYM c
d. 作悶	☐ 1 有	☐ 2 冇	SYM d
e. 極度口渴	☐ 1 有	☐ 2 冇	SYM e
f. 極度疲勞	☐ 1 有	☐ 2 冇	SYM f
g. 四肢無力	☐ 1 有	☐ 2 冇	SYMg
h. 發冷	☐ 1 有	☐ 2 冇	SYM h

4. 總括所有病徵而言，你呢段痾嘔不適持續咗幾多日? _____日 ILLDAY

5. 你認爲你嘅病徵是由什麼所致? ☐ 1 食物傳染 (跳去 a) ☐ 2 由人傳染 (跳去 b) ☐ 3 其他: _____ (跳下題) ILLCAUSE

a. 食物傳染

i. 咁你食錯咗咩呢?

食物 _____ FOOD1

飲料 _____ DRINK

ii. 咁你喺係邊道食呢? ☐ 1 院舍內 ☐ 2 院舍外 PLACE1 PLACEEAT

地方: _____ ☐ 1 香港境內 ☐ 2 香港境外 PLACEHK

iii 咁你喺進食後幾多小時出現腹瀉或嘔吐? _____小時 INCUBAT

b. 由人傳染

i. 你點解覺得係由人傳染呢? WHYPTOP

☐ 1 院舍內有其他人有急性腸胃炎
☐ 2 曾經接觸其他人有急性腸胃炎
☐ 3 空間不流通
☐ 4 院舍太狹窄
☐ 5 其他:_____

求診與治療

6. 你有冇因爲嗰次不適而向西醫、中醫或其他醫護人員求診? ☐ 1 有 ☐ 2 冇 (跳去 6) DOCTOR

醫護人員種類	求診次數	診金 是否連藥物?	支付者 (可選多於一項)
(a) 私家診所的西醫	_____ DOC1a	$____ DOC2a ☐1是 ☐否2 DOC3a	☐1自己 ☐3政府 ☐2家人 ☐4保險 DOC4a
(b) 政府診所的西醫	_____ DOC1b	$____ DOC2b ☐1是 ☐否2 DOC3b	☐1自己 ☐3政府 ☐2家人 ☐4保險 DOC4b
(c) 醫院急症室的西醫	_____ DOC1c	$____ DOC2c ☐1是 ☐否2 DOC3c	☐1自己 ☐3政府 ☐2家人 ☐4保險 DOC4c
(d) 中醫	_____ DOC1d	$____ DOC2d ☐1是 ☐否2 DOC3d	☐1自己 ☐3政府 ☐2家人 ☐4保險 DOC4d
(e) 其他醫護人員(註明) SpecifiyDOCe	_____ DOC1e	$____ DOC2e ☐1是 ☐否2 DOC3e 註明醫護人員:_____	☐1自己 ☐3政府 ☐2家人 ☐4保險 DOC4e

7. 點解你唔去睇醫生? ☐ 1 太昂貴 ☐ 2 病情輕微 WHYNODO
☐ 3 自己吃成藥 ☐ 4 其他: _____

8a. 你有冇提供任何樣本作化驗? ☐ 1 糞便 ☐ 2 嘔吐物 SAMPLE
☐ 3 血液 ☐ 4 冇
☐ 5 其他: _____

b. 化驗結果係: _____ RESULT

c. 要俾幾多錢: _____ SMPPAY

9. 你有冇因嗰次不適而要吊鹽水? ☐ 1 有 ☐ 2 冇 IVFLUID

10. 你有冇因嗰次不適而要打針? ☐ 1 有 ☐ 2 冇 INJECTION

11a. 你有冇就你提及的病徵服用藥物? ☐ 1 有. 咁你食咗幾多日藥: _____日 DRUGDAY
☐ 2 冇 DRUGDAY1

11b 你食咗咩嘢藥? ☐ 1 醫生開嘅藥 ☐ 2 成藥 DRUGSOUR
☐ 3 以前睇醫生食剩嘅 ☐ 4 院舍俾嘅藥
☐ 5 其他: _____

d. 你食咗咩種類嘅藥? ☐ 1 治腹瀉藥物 ☐ 2 治嘔心/嘔吐藥物 DRUGTYPE
☐ 3 治腹絞痛藥物 ☐ 4 退燒/止痛藥
☐ 5 抗生素 ☐ 6 中藥
☐ 7 其他 _____

藥名(如有): _____ DRUGNAME

c. 你買藥用咗幾多錢? $_____ DRUGFEE

社會及經濟影響

1. 你有冇因嗰段不適而錯過半日或以上的消遣或假日活動? ☐ 1 有. _____ 日 ☐ 2 冇 MISSREC
MISSREC1

2a 有冇人因爲你病咗而黎探你或帶你去睇醫生? ☐ 1 院舍職員 ☐ 2 家人 AFFECT
☐ 3 朋友 ☐ 4 其他: _____
☐ 5 冇

b. 佢哋一共花咗幾多時間陪你? _____ 日 AFFECTIME

3a. 仲有冇其他之前未提及過、因你嗰段不適而付出嘅額外開支? ☐ 1 有 ☐ 2 冇 OTHEREXP

b. 事項: 花費: EXPTYPE
EXPFEE

Simplified Barthel Index (得分20) 圈上最合適的狀況

使用扶助用具： 2 無☐ 1 有☐：1 手杖 / 2 手叉/ 3 四方框架 / 4 輪椅

情況	能力狀情	分數	
BOWEL 大便	失禁 (或需用甘油條) 偶然失禁 有自制能力	0 1 2	ASSIST ASSIST1 BOWEL
URINATE 膀胱 (小便)	失禁 (或用導管並同時不能自我處理) 偶然失禁 (24 小時最多一次) 有自制能力	0 1 2	URINATE
WASHFACE 洗面	需人協助洗面 獨立 (用器具)	0 1	WASHFACE
WASHROOM 使用洗手間	要扶助 可獨立做一部份，但需協助 獨立	0 1 2	WASHROOM
EAT 飲食	不能自助 可以但骯髒 獨立 (食物放在前面)	0 1 2	EAT
DRESS 穿衣	要扶助 自己能做一部份 獨立包括扣鈕、拉拉鏈等	0 1 2	DRESS
SHOWER 洗澡	要扶助 獨立 (無需協助)	0 1	SHOWER
TURN 轉動	不能 - 無平衡力 要較大協助 (一至兩個人)、能坐 較少協助 (言語或身體) 獨立 (無需協助)	0 1 2 3	TURN
ACTIVITY 活動能力	難活動 可推輪椅、或兩人協助行路 要一個人扶著或協助 (言語或身體) 獨立 (無需協助)	0 1 2 3	ACTITITY
STAIRS 上落樓梯	不能 要協助 (要言語或身體協助) 可自行上落	0 1 2	STAIRS
			TOTALS

Part II 訪問院舍職員

1. 老人院名稱 /Lorche#: _____ (case / control)		SHOMENO
2. 職員姓名 / 稱呼: _____		SNAME
3.性別: _____		SSEX
4.訪問員姓名 (編號): _____		SINTVNO
5.訪問日期: _____		SDATE
6.開始時間: _____		SSTART
7.結束時間: _____		SEND
8.提供資料者	☐1 感染控制負責人 ☐ 2 其他 : _____	SANSWER
採用代理受訪者原因:	☐ 1 沒有感染控制負責人 ☐ 2 感染控制負責人拒絕受訪 ☐ 3 其他 : _____	SREASONP

9. 拒絕受訪, 未完成或不成功個案備註:
第一次訪問: _____
第二次訪問: _____

如果於訪問期間該院舍有急性腸胃炎病友，問題請跟據該次詳情作答
否則，請跟據平時做法作答

I. 基本資料

1. 老人院種類	☐ 1 私營 ☐ 2 私營(參與改善買位計劃) ☐ 3 津助 ☐ 4 非牟利自負盈	HOMETYPE
2. 所在地區	☐ 1 北區 ☐ 2 大埔 ☐ 3 沙田 ☐ 4 西貢	DISTRICT
3. 收費	每月$ _____	FEE
4. 層數	_____層	FLOOR
5. 現時住院人	_____人	RESIDENT
6. 可容納人數	人	CAPACITY
7. 供院友房間數目	_____間	ROOM
8. 房間平均住	_____人	ROOMCAP

10

9. 房間種類	☐ 固定房間 ☐ 分割式房間	ROOMTYPE
10. 洗手間數目	_____個	TOILET
11. 員工人數		
a. 主管	_____人	STAFF a
b. 感染控制負責人	_____人	STAFF b
c. 保健員 [有沒有包括院舍創辦人(老闆)]	_____人; ☐ 1 有 (c1) ☐ 2 冇	STAFF c STAFF c1
d. 護理員	_____人	STAFF d
e. 註冊護士	_____人	STAFF e
f. 廚師	_____人	STAFF f
g. 留宿員工	_____人	STAFF g
h. 其他: _____	_____人	STAFF h

12. 院舍有冇設立疾病記錄表?	員工	院友 (a)	
a 發燒	☐ 1 有	☐ 1 有	RECORD 1
	☐ 2 冇	☐ 2 冇	RECORD 1a
b. 腹瀉	☐ 1 有	☐ 1 有	RECORD 2
	☐ 2 冇	☐ 2 冇	RECORD 2a
c. 嘔吐	☐ 1 有	☐ 1 有	RECORD 3
	☐ 2 冇	☐ 2 冇	RECORD 3a

13a 如果有員工患了急性腸胃炎, 院舍會:	☐ 1 員工必需出示病假証明書才可申請病假 ☐ 2 了解情況後, 在沒有病假証明書的情況下仍然給予病假 ☐ 3 如人手不足, 患病員工有機會仍要繼續工作 ☐ 4 其他	STAFFILL
b. 患病員工會於沒有病徵後多久天才會復工.	☐ 1 立刻 ☐ 2 一天 ☐ 3 二天 ☐ 4 三天 ☐ 5 其他	REWORK
c.請問你於四星期之內有沒有急性腸胃病的徵狀?	☐ 1 有 ☐ 2 冇 ☐ 1 三次或以上腹瀉 ☐ 2 一次或以上嘔吐	AGESYM AGESYM1
14 a.你地院舍有冇感染控制負責人?	☐ 1 有 : _____人 ☐ 2 冇	PICILL PICILL1
b. 專業資格:	☐ 1 有: _QUALI1_ ☐ 2 冇	QUALI QUALI1

c. 喺過去一個月, 院舍有冇急性腸胃炎爆發? 包括職員及院友 ☐ 1 有 ☐ 2 冇 OUTBREAK

d. 如有懷疑有急性腸胃炎爆發, 你會通知邊個機構? ☐ 1 衛生防護中心
☐ 2 長者健康外展隊伍 (CGAT)
☐ 3 醫管局老人評估小組
☐ 4 社會福利署安老院牌照事務處
☐ 5 其他: _____
☐ 6 沒有通知任何機構 INFORM

15. 於訪問期間至前一個月, 有冇出院病友? ☐ 1 有 ☐ 2 冇 OUTHOSP

16a. 有冇 CGAT 護士/醫生定期到訪? ☐ 1 有 ☐ 2 冇 (跳下題) CGATVISIT

b 幾耐黎一次? 醫生: ☐ 1 每星期 2 次
☐ 2 每星期 1 次
☐ 3 其他:_____ DOCVISIT

護士: ☐ 1 每日 1 次
☐ 2 每星期 5-6 次
☐ 3 每星期 2-4 次
☐ 4 其他:_____ NUVISIT

II. 照顧起居方面

1. a. 你地院舍有冇設立隔離室? ☐ 1 有. _____ 間 ☐ 2 冇 (跳下題) SPZONE
SPZONE1

b. 如果有院友有腹瀉/嘔吐, 你地會唔會將佢地移去隔離室? ☐ 1 會
☐ 2 間中. 視乎嚴重情況
☐ 3 唔會 (跳去 d)
☐ 4 不適用: _____ ILLTOZONE

c. 你地會幾時先將患病院友送返去原本嘅床位? ☐ 1 直至院友完全康復
☐ 2 院友病情受到控制. 但未完全康復
☐ 3 院友要求返回原本床位
☐ 4 其他: _____ WHENBACK

d. 隔離室係屬於 ☐ 1 獨立房間 ☐ 2 固定圍板
☐ 3 流動間隔 ☐ 4 其他 ZONETYPE

e 隔離室有幾多個床位? _____ 個
(如多於一個隔離室. 以最多一間計算) ISOBED

f. 隔離室有冇			
i. 廁所	☐ 1 有	☐ 2 冇	ISO 1
ii. 洗手盆	☐ 1 有	☐ 2 冇	ISO 2
iii. 洗手液	☐ 1 有	☐ 2 冇	ISO 3
iv 乾手設備	☐ 1 有	☐ 2 冇	ISO 4
v. 窗門	☐ 1 有	☐ 2 冇	ISO 5
vi. 抽氣扇	☐ 1 有	☐ 2 冇	ISO 6
vii. 冷氣機	☐ 1 有	☐ 2 冇	ISO 7
3. 患有急性腸胃病院友會唔會同其他健康院友(共用):			
i. 廁所	☐ 1 會	☐ 2 唔會	SHARE 1
ii. 洗手盆	☐ 1 會	☐ 2 唔會	SHARE 2
iii. 乾手設備 (包括毛巾)	☐ 1 會	☐ 2 唔會	SHARE 3
iv. 洗澡地方	☐ 1 會	☐ 2 唔會	SHARE 4
v. 同佮食飯	☐ 1 會	☐ 2 唔會	SHARE 5
vi. 碗筷	☐ 1 會	☐ 2 唔會	SHARE 6
vii. 公衆地方	☐ 1 會	☐ 2 唔會	SHARE 7
4. 你地有冇教導院友正確嘅洗手方法?	☐ 1 有	☐ 2 冇	CORRWASH
5. 你地有冇教導院友幾時要洗手?	☐ 1 有	☐ 2 冇	WHENWASH
6. 你地平均隔幾耐換一次床單?	☐ 3 每星期一次或以上 ☐ 2 一至兩星期一次 ☐ 1 超過兩星期才一次		BEDCOVER
7. 你地平均隔幾耐換一次被袋?	☐ 5 每月一次或以上 ☐ 4 至兩個月 次 ☐ 3 兩至四個月一次 ☐ 2 四至六個月一次 ☐ 1 超過六個月才一次		BLKCOVER
8 你地會點樣處理受糞便或嘔吐物污染嘅:			
a. 床單	☐ 1 熱水洗 ☐ 3 1: 99 漂白水 ☐ 5 其他: _____	☐ 2 高溫燙 ☐ 4 1 49 漂白水	DIRT a
b. 被袋	☐ 1 熱水洗 ☐ 3 1: 99 漂白水 ☐ 5 其他: _____	☐ 2 高溫燙 ☐ 4 1: 49 漂白水	DIRT b
c. 衣服	☐ 1 熱水洗 ☐ 3 1: 99 漂白水 ☐ 5 其他: _____	☐ 2 高溫燙 ☐ 4 1 49 漂白水	DIRT c

d. 地下 ☐ 1 1:99 漂白水 ☐ 2 1:49 漂白水 DIRT d
☐ 3 洗潔精 ☐ 4 普通根水
☐ 5 其他. _____

e. 傢俬 / 其他物件 ☐ 1 1:99 漂白水 ☐ 2 1:49 漂白水 DIRT e
☐ 3 洗潔精 ☐ 4 普通根水
☐ 5 其他 _____

9. 職員喺清理糞便或嘔吐物時會著咩嘢保護自己? (可選多項) ☐ 1 口罩 ☐ 2 手套 PROTECT
☐ 3 圍裙 ☐ 4 保護衣
☐ 5 護目鏡 ☐ 6 護面罩
☐ 7 冇任何保護
☐ 8 其他 _____

10a.職員喺清理糞便或嘔吐物後有冇洗手? ☐ 1 有 ☐ 2 間中, 視乎情況 DISINFECT
☐ 3 冇 (跳下題)

b 咁洗手時會用咩清潔劑? ☐ 1 冇 ☐ 2 根 /根液 WASHAG
☐ 3 酒精啫喱 ☐ 4 其他

c. 有冇更換手套? ☐ 1 有 ☐ 2 間中, 視乎情況 CHANGLOV
☐ 3 冇

III. 環境衛生方面

A. 通風系統

1 a. 你地院舍有冇安裝冷氣系統? ☐ 1 有 ☐ 2 冇 AIRCON

b. 安裝冷氣之地方及系統:

	1 中央	2 分體	3 窗口	4 其他	5 沒有	
a. 院友房間	☐	☐	☐	☐	☐	AIRTYPE a
b. 公眾地方	☐	☐	☐	☐	☐	AIRTYPE b
c 辦公室	☐	☐	☐	☐	☐	AIRTYPE c
d. 隔離室	☐	☐	☐	☐	☐	AIRTYPE d
e 洗手間	☐	☐	☐	☐	☐	AIRTYPE e

2. 你地院舍有冇? 安裝地方:

	1 有	2 冇	院友房間	公眾地方	辦公室	隔離室	洗手間	
a.鮮風機	☐	☐	1☐	2☐	3 ☐	4 ☐	5 ☐	WMACHINE
b 風扇	☐	☐	☐	☐	☐	☐	☐	FAN
c. 抽氣扇	☐	☐	☐	☐	☐	☐	☐	VENTFAN

3. 過去一年有冇訪客. 院友或員工投訴院內空氣混濁? ☐ 1 有 ☐ 2 冇 COMPLAIN

B. 環境衛生

4. 你地會幾耐洗一次·

	a. 廁所	b. 廚房	c. 地板	d. 傢俬	e. 門柄	f. 燈掣	g. 垃圾桶	
每星期次數	_____次	_____次	_____次	_____次	_____次	_____次	_____次	CLEANa CLEANb CLEANc CLEANd CLEANe CLEAN f CLEAN g

5. 你地會用咩嘢去洗:

	1 99 家用漂白水	1 49 家月漂白水	70% 濃度酒精	洗潔精	氯水	清水	其他	
a. 廁所	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 _____	AGENT a
b. 廚房	☐	☐	☐	☐	☐	☐	_____	AGENT b
c. 地板	☐	☐	☐	☐	☐	☐	_____	AGENT c
d. 傢俬	☐	☐	☐	☐	☐	☐	_____	AGENT d
e. 門柄	☐	☐	☐	☐	☐	☐	_____	AGENT e
f. 燈掣	☐	☐	☐	☐	☐	☐	_____	AGENT f
g.垃圾桶	☐	☐	☐	☐	☐	☐	_____	AGENT g

6 你地會唔會定期將漂白水注入廁盆? ☐ 4 每月 4 次或以上 ☐ 3 每月 2 至 3 次 ☐ 2 每月 1 次或以下 ☐ 1 唔會 — DRAINAGE

7. 你地會唔會定期清洗流動便椅? ☐ 5 每當有院友使用後 ☐ 4 每星期 7 次或以上 ☐ 3 每星期 2 至 6 ☐ 2 每星期 1 次或以下 ☐ 1 唔會 — COMCHAIR

8. 你地院舍有冇以下嘅防護裝備可以俾人使用? (可選多項)

	1 員工	2 院友	3 出院院友	4 探訪者	
a. 口罩	☐	☐	☐	☐	PROTECT a
b. 手套	☐	☐	☐	☐	PROTECT b
c. 護面罩	☐	☐	☐	☐	PROTECT c
d. 護目鏡	☐	☐	☐	☐	PROTECT d
e. 鞋套	☐	☐	☐	☐	PROTECT e
f. 帽	☐	☐	☐	☐	PROTECT f
g. 保護衣	☐	☐	☐	☐	PROTECT g

C. 廚房衛生 / 食品處理問題
以下問題將由廚師作答

9 . a. 你喺煮嘢食之前有冇洗手？ ☐ 1 有 ☐2 冇 COOKHAND

b. 你去完洗手間有冇洗手? ☐ 1 有 ☐ 2 冇 (如 10a,b 都冇.跳下題) WASHAND

c 請問你洗手時:

d 有冇用清潔劑？ ☐ 1 冇 ☐ 2 幌 /幌液 SOAP1
☐ 3 酒精啫喱 ☐ 4 其他:_____

e. 會洗幾耐? ☐ 1 少於 5 秒 ☐ 2 5 至 9 秒 WASH1IME
☐ 3 10 至 14 秒 ☐ 4 15 至 19 秒
☐ 5 20 秒或更多

f 會唔會捽下隻手? ☐ 1 會 ☐ 2 間中 ☐ 3 唔會 RUBHAND1

10. 你有冇同其他院友共用毛巾?包括抹手巾 ☐ 1 有 ☐ 2 間中 ☐ 3 冇 SHARETO

11 你工作嘅時候有冇戴圍裙? ☐ 1 有 ☐ 2 冇 APRON

12. 你工作嘅時候有冇戴工作帽? ☐ 1 有 ☐ 2 冇 HAT

13. 你分配熟食嘅時候有冇戴口罩? ☐ 1 有 ☐ 2 冇 MASK

14. 如果你有腹瀉 / 嘔吐. 你仲會唔會返工? ☐ 1 有 ☐ 2 冇 ILLWORK

15. 你有冇上過有關食物衛生嘅正式講座? ☐ 1 有 ☐ 2 冇 TALK

16. 如果你隻手有傷口. 你煮食時會點做? ☐ 1 貼上防水膠布 ☐ 2 不理會 WOUND
☐ 3 其他. _____

17. 你會點樣儲存未立即煮食嘅魚同埋肉? ☐ 1 放入雪櫃 ☐ 2 放於室溫 STORAGE
☐ 3 其他 _____

18. 你有冇兩套唔同嘅刀同埋砧板分開處理生熟食物?

a. 刀 ☐ 1 有 ☐ 2 冇 KINFE

b. 砧板 ☐ 1 有 ☐ 2 冇 CHOPBORD

19. 你會點樣解凍冷藏食物? ☐ 1 放在雪櫃下格 ☐ 2 定時更換或用不停流動的自來水 DEFROST
☐ 3 微波爐 ☐ 4 放於室溫
☐ 5 其他: _____

PART III 訪問員觀察

I. 通風系統

	窗戶	風扇	冷氣機	鮮風機	抽氣扇
1. 安裝數目	WINNUM	FANNUM	AIRCONN	FEVENNUM	VENNUM
2. 啓動數目	WINON	FANON	AIRCONON	FVENON	VENON

II. 環境衛生

A. 起居室(公眾地方)

1. 環境	☐ 1 有臭味 ☐ 1 侷促	☐ 2 冇臭味 ☐ 2 通爽	DINRM 1 DINRM1a
2. 地板	☐ 1 清潔	☐ 2 不清潔	DINRM 2
3. 傢俬	☐ 1 清潔	☐ 2 不清潔	DINRM3
4. 垃圾桶 a) ☐ 1 有 ☐ 2 冇	b) ☐ 1 爆滿 ☐ 2 有空位	c) ☐ 1 有蓋蓋好 ☐ 2 有蓋沒蓋好 ☐ 3 冇蓋	DINRM 4a DINRM 4b DINRM 4c

B. 洗手間

1. 環境	☐ 1 有臭味 ☐ 1 流通	☐ 2 冇臭味 ☐ 2 不流通	WASHRM 1 WASHRM1a
2. 地板	☐ 1 清潔	☐ 2 不清潔	WASHRM 2
3. 廁所	☐ 1 清潔 ☐ 1 有污物未沖去	☐ 2 不清潔 ☐ 2 冇污物	WASHRM 3 WASHRM3a
4. 廁掣	☐ 1 能沖水	☐ 2 不能沖水	WASHRM 4
5. 洗手盆	☐ 1 清潔 ☐ 1 有瘀塞	☐ 2 不清潔 ☐ 2 冇瘀塞	WASHRM 5 WASHRM5a
6. 洗手梘 / 梘液	☐ 1 有設備, 有梘 / 梘液	☐ 2 有設備, 冇梘 / 梘液	☐ 3 冇設備 WASHRM6
7. 抹手紙	☐ 1 有設備, 有紙	☐ 2 有設備, 冇紙	☐ 3 冇設備 WASHER7
8. 乾手機	☐ 1 有設備, 運作正常	☐ 2 有設備, 不能運作正常	☐ 3 冇設備 WASHER8
9. 共用抹手巾	☐ 1 有 ☐ 1 清潔	☐ 2 冇 (跳下題) ☐ 2 不清潔 **a**	WASHRM 9 WASHRM9a
10. 個別抹手巾	☐ 1 有 ☐ 2 冇 (跳下題)	☐ 1 清潔 2 不清潔 **a**	WASHRM10 WASHRM10a
11. 垃圾桶 a) ☐ 1 有 ☐ 2 冇	b) ☐ 1 爆滿 ☐ 2 有空位	c) ☐ 1 有蓋蓋好 ☐ 2 有蓋沒蓋好 ☐ 3 冇蓋	WASHRM11a WASHRM11b WASHRM11c

C. 廚房

1. 環境	☐ 1 有臭味 ☐ 2 冇臭味	KITCHEN 1
2. 地板	☐ 1 清潔 ☐ 2 不清潔	KITCHEN 2
3. 雪櫃		
a. 有臭味	☐ 1 有 ☐ 2 冇	KITCHEN 3a
b. 食物擺放過於擠逼	☐ 1 有 ☐ 2 冇	KITCHEN 3b
c. 生熟食物都包好/ 蓋好	☐ 1 有 ☐ 2 冇 ☐ 3 不適用	KITCHEN 3c
d. 熟嘅食物放上格. 生嘅食物放下格	☐ 1 有 ☐ 2 冇 ☐ 3 不適用	KITCHEN 3d
e. 雪櫃設有冰格專門放生嘅食物	☐ 1 有 ☐ 2 冇	KITCHEN 3e
f. 設有兩個雪櫃分開放生熟食物	☐ 1 有 ☐ 2 冇 ☐ 3 不適用	KITCHEN 3f
g. 當時雪櫃溫度:	☐ 1 < 0 °C ☐ 3 4°C - ≤ 8 °C ☐ 2 0 °C - <4 °C ☐ 4 > 8 °C	KITCHEN 3g
4. 工作枱	☐ 1 清潔 ☐ 2 不清潔	KITCHEN 4
5. 抽油煙機	☐ 1 清潔 ☐ 2 不清潔	KITCHEN 5
6. 碗布	☐ 1 清潔 ☐ 2 不清潔	KITCHEN 6
7. 圍裙	☐ 1 清潔 ☐ 2 不清潔	KITCHEN 7

D. 隔離室

1. 有冇被非病友佔用作長期房間	☐ 1 有 ☐ 2 冇	ISOROM1
2. 於訪問期間隔離室是否可供入住	☐ 1 可以 ☐ 2 不可以, 原因: ____	ISOROM2 ISOROM2a
3. 於訪問期間隔離室有冇病人入住	☐ 1 有 : ___ 人 ☐ 2 冇	ISOROM3 ISOROM3a