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Learning from the severe acute respiratory syndrome (SARS) epidemic

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Aims and objectives. This study uses two models of nursing practice, conventional and modular design, to compare nursing activities, hand hygiene, time efficiency and nurse–patient satisfaction in medical and surgical wards.

Background. Learning from the SARS epidemic pointed to the importance of quality nursing practice considerations that minimize cross-transmission of infection while maximizing patient-focused care. Hence, a modular nursing model was adopted.

Design and method. This study comprised pre- and postintervention phases. Data collection tools to evaluate modular nursing practice included a work sampling observation checklist, focused group interviews with nurses, questionnaires addressing nurses' perceived competence and caring attributes, a patient satisfaction questionnaire, and a hand hygiene audit. A series of education sessions were conducted between the two phases. Quantitative and qualitative analyses were used for data triangulation.

Results. Modular nursing practice, focusing on continuity of care, led to changes in the nature of direct care activities and improvement in patient/family education frequency. Also, a general increase in nurses' hand washing frequency was noted. However, when nurses perceived time pressure, a lapse in hand hygiene compliance was found. Because of human resource and inefficiency issues, some nurses in the studied wards did not embrace geographical separation for infection control. Positive correlations were found for nurses' perceived infection control practice competence and their perceived caring attributes.

Relevance to clinical practice. In examining nursing practice models within complex clinical situations, the significance lies not only in the model's effects but also in other operational outcomes.

Key words: continuity of care, Hong Kong, infection control, nurses, nursing models, severe acute respiratory syndrome (SARS)

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Introduction

Although the SARS epidemic now seems like a distant event, we continue to learn from its impact on clinical practice. Working with SARS patients, nurses not only learned about the importance of infection control measures but also about patients' psychosocial needs (Chan *et al.* 2005). However, as the SARS threat loses its potency, the hand washing vigilance of nurses has lessened, especially due to time constraints caused by heavy workloads. Cochrane (2003) echoed that nurses' hand washing practice, the most basic and important infection control measure, is affected by lack of time. As for patients' psychosocial needs, not only is there a trend towards holistic care but also reason to believe that states of subjective distress affect immune functioning, thereby increasing patients' susceptibility to infection (Stone *et al.* 1987).

In Hong Kong, nurses face workload and time constraint issues daily. They have frequently indicated that, due to workload demands, they are unable to spend time talking with patients. Time constraints have led to the practice of functional-team nursing, which promotes efficiency and task completion. The underlying assumption is that timely completion of nursing tasks translates into the delivery of comprehensive, appropriate and good care.

Minen *et al.* (2003) critiqued functional nursing's focus on task completion and adherence to ward routine at the expense of individual patients' needs. Furthermore, Aiken *et al.* (2000) demonstrated that patient outcomes improved when professional practice characteristics were emphasized over task-centered behaviours. One such characteristic referred to nurses' ability to establish and maintain therapeutic relationships with patients through continuity of care. In rounds within a simulated clinical setting, it has been shown that a paradigm shift in nursing, from a routine task-orientation to prioritized patient-focused care, lessened the potential of cross-contamination for care of the same patient and for in-between patient care (Chan *et al.* 2006). Hence, in an attempt to improve overall patient care and to develop better infection control practices, our research team asked whether there is a more effective nursing care delivery model. We set out to examine nurses' use of time and use of standard precautions such as hand washing to improve patient care within a more humanistic modular care design compared with the existing predominately functional-team delivery mode.

Nursing models

Nursing models have long been employed for systematic and coherent care delivery. These models also facilitate the practice of nursing values and can reflect the structural, contextual and essential features of nursing practice. Traditionally, three theoretical nursing models are found within hospital settings. They are functional nursing, team nursing and primary nursing. The modes of delivering care that are characteristic of the bureaucratic practice model are functional nursing and team nursing, and task allocation is an integral component.

Studies have examined how to replace such mass production models with a system of responsibility. A model emerged that assigned a primary nurse to care for a group of patients (Manthey 1980, Hoggett 1994). The cornerstone of primary nursing is the importance of the relationship between patients and nurses. Other studies have shown that hospital wards generally do not organize their nursing activities in accordance with one particular delivery model (Anderson & Choi 1980, Adam & Hardey 1992, Ryan & Logue 1998). Anderson and Hughes (1993) proposed a modular nursing model, which is characterized by a mix of team and primary nursing. The benefits of this model are marked by improvements in continuity of care, accountability for client outcomes and effective use of the staff mix in a long-term care facility. Nardone *et al.* (1995) indicated a financial improvement after a change to a modular care delivery system in an acute hospital.

This study adopted a modular nursing, modified team and primary nursing approach (Tomey 2000). The aim of the modular model is to foster increased knowledge of patients through total care, continuity of care and a patient-focused orientation. It emphasizes patient and family involvement in care and a direct communication pattern, i.e., some of the inherent benefits of primary nursing (Thompson 1990). Knowing the patient through total care and continuity of care in a modular design has been shown to decrease the time taken to meet individualized needs (Anderson *et al.* 1993), which might enable more efficient care. Furthermore, when a fixed number of nurses are involved in the care of a designated group of patients, there is less likelihood of cross-infection between nurses and patients. Geographical separation translates into an infection control strategy. Confined to work within a designated module, nurses do not leave their module to help others in a different module, which lessens the chance of contagion. Additionally, this model might support Tanner *et al.*'s (1993) notion of nurses' engagement, which results in patients' feeling cared for and about.

In a modular design, the module, as a patient unit, is geographically organized with a small team of registered nurses (RN) permanently assigned to it for the total care of a patient group. A ward is divided into modules. When patients are admitted to the ward, they are allocated to a module.

Each module has a defined number of patients. Within a designated module, each nurse, along with health care assistants, works as a modular partner with others in attending a group of patients providing continuity of care.

Methods

The design was a descriptive quasi-experimental one with modular nursing as the intervention. The study was also correlational, employing different criteria parameters to compare subject's performances. Different nursing practice models within the same ward were used over the pre- (T_0) and post- (T_1) intervention phases.

Ethical procedures

Ethical approvals were sought from the ethical review boards of both the university and the hospital. Thereafter, a meeting with the general manager of nursing was held. Three wards were identified. The selected wards included two surgical – orthopaedic (S1) and urology (S2) – and one medical – (M1) wards.

Settings

At the time of the study, both surgical wards had an average of 35 patients with a general daily nursing staffing of five in S1 and 5–7 in S2. Originally an infection isolation ward, the medical ward has been allocated as a general medical ward. During the study period, it had 17 beds with an average of only 10 patients and a staffing of four. All wards have a skill mix of RNs and one or two health-care assistants (HCA). The nurses' clinical experience ranged from 1–15 years and the distribution was similar across all three wards. Surgical ward nurses had not previously attended SARS patients, while their medical ward colleagues had cared for a few isolation cases.

The nurse managers of these wards informed staff that a modular nursing model would be implemented for the study. Several focus group meetings were then conducted with senior nursing officers from the three wards. The research team explained the purpose of the study, the model's design and solicited their input regarding the proposed structural changes. A series of staff education sessions for the three wards followed after data collection for T_0. Prior to soliciting nurses' consent, the purposes of the research were fully explained. The participants were informed that their performance data would not be revealed to anyone except the research team. They had full knowledge that they could withdraw from the study at any time. Written consent from the nurse-participants was obtained prior to their interviews. Confidentiality and anonymity were assured.

Data collection and analysis

For the planning of the T_0 phase, observations of nursing activities based on a work sampling method, statistical sampling and random observations were carried out. For the work sampling method, nursing activities from the observation checklist were identified from workflow data of the pilot study that was conducted in a simulated ward and based on similar work sampling instruments from the literature. This checklist was validated by the senior nurses of the studied wards (82% content validity index). As commonly found in literature, different categories were used for the observed activities (Fitzgerald *et al.* 2003): direct care, indirect care, unit care and personal care. Definitions of the activity categories in the work sampling check sheet are shown in Table 1. Data collection tools included observations of nursing activities, focus group interviews, questionnaires for nurses addressing

Table 1 Definitions of activity categories

Activity categories	Definitions
Direct care category	It included all activities performed in the presence of the patient and/or family such as admission of patient, administration of medications, all treatments and procedures, specimen collections and all aspects associated with grooming, bathing, eating, toileting, bed transfer, hallway transport as well as communication with patient and family for teaching.
Indirect care category	It included activities preparing for or completing patient care assignments, such as preparing medications and treatments, hand washing, giving shift report, seeking consultation through phone conversation, conferring with other members of the health care team and documenting care given.
Unit care	It referred to those activities necessary for the general coordination of the unit or patient well-being such as care of equipment, ordering/delivering of supplies, use of computer.
Personal care	It referred to activities such as coffee and meal breaks, socializing with others and when the nurses could not be found by the observer or attending in-service.

their caring attributes and competence, a patient satisfaction questionnaire, and a hand hygiene audit.

Once the observation checklist was constructed, data collection for the T_0 phase began with nursing observations (convenience sample) of multiple nursing personnel by an independent observer. In discerning the nature and frequency of nursing activities, 3 491 total observations were collected over 14 randomly selected days in the three studied wards: S1 (1 319 observations) S2 (1 318 observations) and M1 (854 observations). The research team identified from professional experience and other empirical findings (Hale 1988, Carr-hill *et al.* 1992) the periods when most nursing activities and nurse–patient interactions occur. Thus, the randomized days consisted of either morning or evening care periods of eight hours. Data collection took 4–6 days, over a three-month period, in each of the three wards during T_1 and T_2. For a comparison of their practices, semi-structured nurses' interviews were conducted with nurses to explore their views on their existing practice at T_0, and at T_1 and T_2, nurses' views of their existing practice and the modular design were being explored. Questionnaires used for the nurse's self-report on their competence (91% CVI, 0·81 alpha reliability) and caring (alpha reliability 0·77) achieved face and construct validity (Arthur *et al.* 1998). Patient satisfaction responses were collected through a modified La Monica–Oberst Patient Satisfaction Scale (Munro *et al.* 1994) using a five-point Likert scale with back-translation (alpha reliability 0·97 and our own pilot, 0·96 reliability). Instead of using a contrived hand hygiene monitoring research exercise for the infection control audit, the research team integrated this research component into the hospital's regular hand hygiene audit practice. Before the T_1 phase, several education sessions were hosted for staff from the three studied wards; unit-specific issues were raised and the operations of the model were adjusted accordingly. The research team provided a structural framework that focused on the continuity of patient care, geographical separation and the promotion of task grouping from clean to dirty procedures. A total of 7 278 observations was collected at T_1 and T_2. During T_1 and T_2, there were 1 580 and 1 382 observations in S1; 1 365 and 1 647 observations in S2; and 767 and 537 observations in M1, respectively.

Descriptive and statistical analyses were conducted with data from the observations and questionnaires. Content analysis was carried out on the qualitative data from nurses' interviews. Subjective data helped to corroborate and clarify observations from work sampling, lending credence to the findings and interpretations.

Results

Findings from work sampling

The increase and decrease in the percentages of time spent in direct care per day varied for the three wards (Table 2). However, there was a general increase in the percentage of direct care in T2 from T0. The variation did not merely represent the percentage of direct care, but the kind of nurse–patient contact. Activities associated with the design are highlighted in Table 3. Changes were thought to be design-related because hand washing was included in the educational session and hand washing posters, as reminders, were posted in patients' rooms. In addition, the design promoted patient-focused care, as it incorporated more time spent on patient and family education. Some nurses commented about changes in their activities. They identified differences from

Table 2 Work sampling observations by category with the adjusted nurse–patient ratio per day

		f (%), *t*			
Ward	Category	T0	T1	T2	T1 + T2
S1	Direct care	29 (15·5), 1·24	52 (18·6), 1·49	35 (17·1), 1·37	(17·9), 1·43
	Indirect care	119 (63·0), 5·04	170 (60·7), 4·9	122 (59·0), 4·7	(60), 4·79
	Unit care	8 (4·2), 0·34	12 (4·3), 0·34	10 (4·8), 0·38	(4·55), 0·36
	Personal care	33 (17·5), 1·4	46 (16·4), 1·31	40 (19·3), 1·54	(17·9), 1·43
M1	Direct care	23 (15·8), 1·26	7 (10·4), 0·83	13 (21·3), 1·7	(16), 1·28
	Indirect care	81 (55·5), 4·44	37 (55·2), 4·42	29 (47·5), 3·8	(51·4), 4·11
	Unit care	8 (5·4), 0·43	4 (6·0), 0·48	3 (5·0), 0·4	(5·5), 0·44
	Personal care	34 (23·3), 1·86	19 (28·4), 2·27	16 (26·2), 2·1	(27·3), 2·18
S2	Direct care	33 (18·5), 1·48	34 (17·7), 1·42	30 (18·9), 1·5	(18·3), 1·46,
	Indirect care	97 (54·8), 4·38	128 (56·2), 4·5	87 (54·7), 4·38	(55·5), 4·44
	Unit care	8 (4·6), 0·37	9 (4·7), 0·38	7 (4·4), 0·35	(4·55), 0·36
	Personal care	39 (22·0), 1·76	41 (21·4), 1·71	35 (22·0), 1·76	(21·7), 1·74

f, no. of observations, *t*, time with patients in hours per day. The percentage may not add to 100 due to rounding. The hour may not add to eight hours exactly due to rounding.

Table 3 The overall percentages of time spent by a nurse per day on per *activity that was clearly associated with the modular design and other activities that merit attention across the pre- and postintervention phases for the surgical wards (orthopedic S1, urology S2) and the medical ward (M1) with nurse–patient ratio adjusted

		f (%) [%]			
Ward	List of activities	T0	T1	T2	T1 + T2, (%) [%]
S1 Direct Care	Hallway transfer	1·4 (4·8) [0·74]	1 (1·9) [0·34]	2 (6·7) [1·1]	(4·3) [1·44]
	Catheter care	0 (0·0) [0·0]	0·12 (0·2) [0·0]	0 (0·0) [0·0]	(0·0) [0·0]
	*Patient and family education	1 (4·2) [0·7]	3 (6·6) [1·2]	3 (7·7) [1·3]	(7·15) [1·25]
S1 Indirect Care	*Shift change activities	24 (19·8) [12·5]	34 (19·9) [12·1]	27 (22·1) [12·9]	(21) [12·5]
	*Hand washing	2 (2·0) [1·3]	3 (1·5) [0·9]	2 (1·9) [1·1]	(1·7) [1·0]
	Break/chatting	31 (92·9) [16·0]	46 (99·0) [16·4]	39 (97·6) [19·0]	(98·3) [17·7]
M1 Direct Care	Hallway transfer	1 (3·5) [0·52]	0 (0·0) [0·0]	1 (7·7) [1·6]	(3·85) [0·8]
	Catheter care	0 (0·0) [0·0]	0 (0·0) [0·0]	0 (0·0) [0·0]	(0·0) [0·0]
	*Patient and family education	0·13 (0·6) [0·1]	0·07 (1·0) [0·1]	0·48 (3·7) [0·8]	(2·35) [0·9]
M1 Indirect Care	*Shift change activities	21 (25·9) [14·3]	9 (24) [13·9]	6 (21·0) [9·9]	(22·5) [11·9]
	*Hand washing	1 (0·8) [0·4]	1 (1·6) [0·9]	1 (3·6) [1·7]	(2·6) [1·3]
M1 – Personal care	Break/chatting	33 (97·1) [22·7]	19 (99·3) [27·7]	16 (100·0) [26·3]	(99·65) [27]
S2 Direct Care	Hallway transfer	2 (5·8) [1·1]	1 (2·9) [0·5]	3 (10·5) [2·0]	(6·7) [1·25]
	Catheter care	1 (2·6) [0·5]	2 (5·1) [0·8]	1 (4·0) [0·8]	(4·55) [0·8]
	*Patient and family education	1 (3·5) [0·65]	3 (8·1) [1·3]	3 (9·0) [1·7]	(8·55) [1·5]
S2 Indirect Care	*Shift change activities	26 (26·3) [14·4]	28 (22·0) [13·3]	20 (23·0) [12·7]	(22·5) [13]
	*Hand washing	1 (1·3) [0·7]	2 (1·8) [1·1]	2 (2·3) [1·2]	(2·05) [1·2]
S2 Personal care	Break/chatting	37 (95·9) [20·9]	41 (99·0) [19·3]	35 (99·2) [22·1]	(99·1) [20·7]

f, no. of observations; (), divided by observations of the category; [], divided by total observations per day.

the shift towards greater continuity of care, which increased their knowledge of patients. Nurses in the modular design were asked to spend at least five minutes daily talking with each patient to discuss their latest concerns.

An increase in the percentage of nurse to patient/family teaching activities per nurse per patient day was observed at T_1 and T_2 for all three wards. Noteworthy was the increase in the percentage of catheter care activities in the urology ward (S2). Neither the increase was affected by the rise or fall in the nurse–patient ratio at T_1 and T_2, nor was the ratio adjusted, which suggests an association with the intervention.

An operational issue was identified related to patient transport. Despite a decline in the percentage of hallway transfers at T_1, there was a dramatic increase in such transfers for all three wards at T_2. Nurses, at the focus group interviews, emphasized decreased resources and increased pressure that result when colleagues leave the ward for patient transport. This issue warrants careful attention should geographical separation or continuity of care be instituted.

Regarding the total observations of the distribution of indirect care per eight hours, differences were associated with a general decrease in the amount of time spent on shift report. Table 2 shows that in M1 a change was noted from 14·3%/1·14 hours (T_0) to 11·9%/0·95 hour ($T_1 + T_2$); for S1 and S2, the change was from 12·5%/1 hour and 14·4%/1·15 hours in T_0 to 12·5%/1 hour and 13%/1·04 hours ($T_1 + T_2$) respectively. These changes are supported by data from nurses' interviews. They ascribed the decrease in report times to 'knowing' the patients, which means that report times could be shortened with continuity of care. In general, an increase in hand washing activities in the indirect care categories was noted for M1 and S2. However, hand washing activities in S1 decreased. Judging by interview data, this change seems related to their attempt at task grouping. Although task grouping minimized task rounds, nurses in the other wards did not find it very beneficial since they could not group many tasks at a time for an individual patient. Therefore, it did not help them to cut down on hand washing.

There was also a general increase from T_0 to T_2 in the category of personal care. Within this category, personal break time was the dominant observed activity, which also increased per day from T_0 to T_2.

While some staff of the studied wards displayed much resistance to the change during the initial T_1 phase, with support from and consultation with senior management and the research team, gradual acceptance was noted. Chi-square analysis revealed a significant difference in the distribution of care during the entire period for each phase ($p < 0{\cdot}001$) for M1, but for S1 and S2 ($p = 0{\cdot}147$) and ($p = 0{\cdot}149$). Post hoc comparison between phases for M1, T_0 vs. T_1 ($p = 0{\cdot}023$), T_0 vs. T_2 ($p = 0{\cdot}051$) and T_1 vs. T_2 ($p < 0{\cdot}001$); for S2, T_0 vs. T_1 ($p = 0{\cdot}124$), T_0 vs. T_2 ($p = 0{\cdot}986$) and T_1 vs. T_2 ($p = 0{\cdot}024$); for S1, T_0 vs. T_1 ($p = 0{\cdot}304$), T_0 vs. T_2 ($p = 0{\cdot}167$) and T_1 vs. T_2 ($p = 0{\cdot}151$). The significant differences identified for M1

Table 4 Results from nurses' focus group interviews on continuity of care for the postintervention phases

Perceived no increase in nurse–patient interaction (2%)	Perceived not many changes in nurse–patient interaction from continuity of care (44%)	Perceived benefits of nurse–patient interaction from continuity of care (54%)
…it has been done all along.	Time is of the essence and [such interaction is possible] only if we have time.	It increases my understanding of patients' needs for discharge planning.
	…would have talked to patients during some nursing procedures.	It enhances nurse–physician communication, which promotes my professional role.
	Patients did not need additional information since many of them were clear about their reasons for surgeries.	… it enables me to identify a patient with depressive symptoms and intervene accordingly, i.e the patient was moved closer to the nursing station.
	A shorter stay would not allow this to happen.	…improves the level of nurse–patient trust, resulting in patient compliance in treatment and less misunderstanding.
	Turnover is high.	Knowing more about the patients allows me to communicate with their families about their needs.
		…increases interactions with patients enhances my accountability/commitment to patient care, e.g. ensuring my follow-up on the patient's need to have his menu changed as promised.
		…increases level of satisfaction for both the nurse and the patient.
		…enables you to explain the visitor policy with much ease when the family knows you.
		…enables me to act as a bridge for physician–patient communication, e.g. in HIV cases.
		Knowing that the patient will be under my continuous care in my module increases my accountability.
		…want to do more for the patient, e.g. more education, etc.
		…could promote safety in medication administration since you are more familiar with the patients.

may reflect the different natures of medical and surgical wards. The change in the T_1 vs. T_2 phases may reflect staff transition as they adjusted to the changes.

Data from focus group interviews

A content analysis of the interview data addressed the domains of continuity of care, efficiency and infection control. Overall percentages were calculated for each category. The interviewed nurses were those who had been observed over a span of three months for each time period, T_0, T_1 and T_2. The total number of bedside nurses in the three wards was 44. For the premodel phase, $n = 19$ and for the postmodel phases, $n = 15$ and $n = 19 + 3$ nurses-in-charge.

Continuity of care

Nurses who commented that there was no increase in nurse–patient interactions in T_1 and T_2 attributed this to the fact that the practice/care was the same (2%) and those who indicated that there were not many changes in their patient interactions as a result of the modular design (44%). They referred to the issues of time and the nature of patients. As illustrated in Table 4, nurses who perceived the benefits of increased nurse–patient interactions covered the areas of better nurse–patient interactions, nurse–physician communication and nurse–family communication, as well as professional role enhancement, increased nurse–patient satisfaction and promotion of safety (54%). While there was no tremendous difference in the percentages, there was an overall change from the nurses' initial views about continuity of care, as many indicated that they had practiced patient-focused care all along.

Efficiency

Nurses who claimed that efficiency of practice decreased (50%) after the intervention attributed this to supply issues,

Table 5 Results from nurses' focus group interviews on efficiency for the postintervention phases

Perceived lower efficiency (50%)	Perceived no difference in efficiency (24%)	Perceived higher efficiency (26%)
…the time spent waiting around for equipment since the task rounds were minimized in the alternative model.	We worked with cubicle nursing previously and also helped others in other cubicles, so working with the modular partners was the same.	…familiarity with my own cases decreases the time needed for shift reports.
…waiting for someone to help or for the in-charge nurse to deploy given the geographical separation of modules for the confinement of care and contacts.		…don't have to start from the beginning in the shift report.
Despite the introduction of patient classification, the physical size of the ward did not facilitate moving of beds. We have many unexpected inflow and outflow cases at times.		…follow-up on patients was better since colleagues from the next shift were familiar with the patients as well. Assessment of the patients was faster since it was building on previous knowledge.
…many operation cases; the pace was fast and we needed help from colleagues of the other module, but they were not able to cross the module boundaries.		…care for the patient could be better organized so one could minimize the number of trips in and out of the room.
…during the transport time there would only be my modular partners for assistance rather than any of the nurses on the ward		
increased time to learn about patients conditions from the charts in response to patients families if patients were not in my module during visiting hours.		

human resources, work demands, workload imbalance, aspects of patient census and having to answer visitors' questions. Comments are shown in Table 5. Since efficiency has been well documented as one advantage of the task-oriented functional approach within a team, it is positive that 26% of respondents noted an increase in efficiency and 24% indicated no difference. Certainly one needs to qualify the term efficiency within a context, i.e., the efficiency of the ward vs. that of an individual module.

Infection control

Table 6 illustrates the comments of nurses who claimed that infection control practice had remained the same (31%): those who believed that the modular design had not influenced infection control practice (31%) and those who believed that it had enhanced infection control (38%). Nurses who did not believe that cross-transmission could be ameliorated by geographical separation offered reasons for their beliefs. They also described their discontent with team morale when assistance from colleagues from another module could not be rendered even when colleagues had available time.

Findings from questionnaires of nurses' caring attributes and competence and from the infection control audit

The only significant findings were the medical ward nurses' responses about their caring attributes over the pre- and postmodel phases. Previously, this ward was an infection control ward, which was staffed by nurses who were self-evaluated to have a good knowledge base for infection control. In the ANOVA test of sum scores, there was a significant difference in nurses' reported views on their caring practice ($F = 14{\cdot}07$, $P < 0{\cdot}001$; T_0 vs. T_2: $P < 0{\cdot}001$ and T_1 vs. T_2: $P = 0{\cdot}018$). These findings were consistent with those from their focus group interviews. While the general view of these nurses at T_0 was that interactions with patients were minimal because of their background in working with infection control patients and because of inadequate time, comments about nurse–patient interactions at T_2 were more positive. Some actually indicated that the increase was facilitated by guidance from the model and its emphasis on the psychosocial dimensions of patients. In the work sampling observations, it was also noted that the model encouraged continuity of care, which enabled the nurses to be more

Table 6 Results from nurses' focus group interviews on infection control for the postintervention phases

Perceived their infection control practice as staying the same (31%)	Perceived no influence in infection control with geographical separation and continuity of care (31%)	Perceived a difference in nfection control with geographical separation and continuity of care (38%)
We have always washed hands and followed guidelines.	Infection control practice is about the nurse's own knowledge and personal behaviour.	…since it could reduce the number of patient contacts.
	It is about the patients moving about in the ward.	…familiarity with the patients allowed better use of infection control knowledge.
	…geographical separation does not stop the patient from moving between and among modules.	…we were vigilant with hand washing when crossing cubicles if needed.
	It is about clustering the same type of patients into one cubicle.	MRSA was limited to a certain module so it would minimize contact.
		…organizing the activities into a set from clean to dirty helped with infection control but was not so efficient.
		…we are more aware of hand washing.

aware of the needs of patients and families. In M1, there was an increase in time per patient per day for patient and family education from 0·11 minute (T_0) to 0·32 minute ($T_1 + T_2$).

As for the competence questionnaire, there was also a significant difference from the sum scores in M1 between the pre- and postmodel phases in the various dimensions (Table 7). The dimensions comprised of managing situations, psychosocial support and professional role. After factor analysis of the questionnaires, a correlation test was performed to discern the associations between nurses' perceptions of their caring attributes and their competence in care. Correlations were noted for M1 only at T_2 ($n = 12$, $r = 0{\cdot}685$, $p = 0{\cdot}014$) and $T_1 + T_2$ ($n = 16$, $r = 0{\cdot}507$, $p = 0{\cdot}045$).

A significant correlation using the sum scores for all three wards at $T_1 + T_2$ and at T_2 was found. In using sum scores between nurses' perceived competence for all the dimensions and their perceived increase in their caring attributes, the results were positive at both $T_1 + T_2$ ($n = 60$, $r = 0{\cdot}447$, $p < 0{\cdot}001$) and at T_2 ($n = 43$ and $r = 0{\cdot}538$, $p < 0{\cdot}001$). Given that no correlation was found at T_0 with nurses' perceived competence and caring attributes, one might conclude that modular nursing had a continuous effect on the nurses' changed perceptions.

A significant correlation in competence for infection control practice between how well and how often was noted at T_1 and T_2, but not at T_0 for any of the three individual wards. M1 ($r = 0{\cdot}78$, $p = 0{\cdot}003$) and one of the surgical wards, S2 ($r = 0{\cdot}73$, $p = 0{\cdot}01$), showed significance at T_2, while for S1 a correlation was noted at T_1 ($r = 0{\cdot}79$, $p = 0{\cdot}01$) and T_2 ($r = 0{\cdot}73$, $p = 0{\cdot}01$). These findings indicate a stronger perceived ability to carry out expected infection control practice in patient care as performance of the practice was expected more frequently.

Table 8 describes the infection control audit for the three wards over the three phases. An initial glance shows that both surgical wards had a smaller percentage for hand washing compliance during T_1. However, with the adjusted common number of observations, the number of successes for T_0 in S1 21/42 was actually less than 35/42 (T_1) and 36/42 (T_2), respectively. Nevertheless, S2 did have a slip from T_0 to T_1 with the same number of four observations for the procedure.

Table 7 Nurses' competence scores by category in M1

		Mean ± SD[Range]			
Ward	Category	T0	T1	T2	ANOVA [*post hoc* test]
M1	A	15·8 ± 2·2 [14·0–19·0]	14·5 ± 1·3 [13·0–16·0]	18·3 ± 1·4 [15·0–20·0]	F = 10·5 $p = 0{\cdot}001$ [Z($p = 0{\cdot}002$)]
	B	12·5 ± 0·6 [12·0–13·0]	11·5 ± 1·9 [9·0–13·0]	14·8 ± 1·2[12·0–16·0]	F = 1·5, $p < 0{\cdot}001$ [Y($p = 0{\cdot}001$), Z($p = 0{\cdot}015$)]
	C	11·0 ± 2·7 [7·0–13·0]	12·0 ± 2·2 [10·0–15·0]	14·6 ± 1·3 [12·0–16·0]	F = 7·4, $p = 0{\cdot}005$ [Y($p = 0{\cdot}008$)]

ANOVA, analysis of variance; *post hoc* test: Y, T0 vs. T2, Z, T1 vs. T2. Dimension A has five items, scores range from 5 to 20; dimensions B and C, both have four items, scores range from. 4 to 16.

Table 8 Results of infection control audits

Procedures	T0		T1		T2	
	O	C	O	C	O	C
S1 Ward						
Before and after aseptic procedure	5	5	7	7	7	7
Before and after touching wound	2	2	6	5	7	6
After respiratory suction	4	4	1	1	0	0
After nasogastric tube insertion	1	1	2	2	1	1
After care of patient on contact precautions	3	3	7	7	3	3
After care of elimination	2	2	5	5	5	5
After handling refuse	0	0	0	0	0	0
Total	17	17	28	27	23	22
S2 Ward						
Before and after aseptic procedure	4	4	4	4	5	5
Before and after touching wound	4	4	4	3	3	3
After respiratory suction	3	3	2	2	0	0
After nasogastric tube insertion	1	1	3	3	0	0
After care of patient on contact precautions	1	1	2	2	0	0
After care of elimination	2	2	2	2	2	2
After handling refuse	0	0	1	1	0	0
Total	15	15	18	17	10	10
M1 Ward						
Before and after aseptic procedure	3	3	2	2	2	2
Before and after touching wound	4	4	4	4	4	4
After respiratory suction	4	4	3	3	4	4
After nasogastric tube insertion	0	0	3	3	5	5
After care of patient on contact precautions	1	1	0	0	0	0
After care of elimination	1	1	3	3	3	3
After handling refuse	0	0	0	0	0	0
Total	13	13	15	15	18	18

O, no. of observation; C, no. of compliances

Further investigation into the procedure revealed that, in this instance, hand hygiene compliance referred to hand washing before and after a wound was 'uncovered' and 'covered' for the doctor's rounds. Apparently, this procedure often occurred because of unanticipated doctor's requests, hence there might have been perceived time pressure. Pre- and postintervention phase data from focus group interviews revealed that nurses were unlikely to wash hands when they faced time constraints.

Results from patients' questionnaires

Data were collected at three different times and comparisons were of cross-sections of patients at T_0 $n = 41$, at T_1 $n = 41$ and at T_2 $n = 42$. Different randomly selected patients were sampled at each time period. Each had been hospitalized for more than two days and was in stable condition. The ages of patients ranged from 23–89 years with a mean age of 56 years. Patients' education ranged from primary to tertiary level. The total sample comprised 102 males and 22 females. Patients' mean length of stay was 11·8 days.

The patient questionnaire addressed patient's perceived affective and instrumental care from the nurses. Among the three studied wards, there were no significant differences across three phases except for S2. A significant difference was found for the item: 'I feel the nurse understands me when I share my problems' (T_1 vs. T_2: $P = 0{\cdot}047$; multiple comparison: T_0 vs. T_2, $P = 0{\cdot}024$). The Mann Whitney U test showed that the significant difference lay between T_0 and T_2 ($p < 0{\cdot}017$).

Despite no overall statistically significant differences in patient satisfaction scores between the pre- and postintervention phases for all the studied wards, it might be postulated that nurse–patient ratio influenced patients' expectations of nurses. The work sampling showed a continuous increase in the frequency of patient/family education despite an increase in patients' demands on nurses in T_1 in both surgical wards. Comparing T_1 with T_0, an increase in the nurses' workload in relation to a higher nurse–patient ratio was observed (1:9·4 vs. 1:7·6 and 1:9·9 vs. 1:8·9) in the two surgical wards; patients seemed to demonstrate greater appreciation of the nurses with higher scores (Table 9).

Interestingly, the general decline in the patient satisfaction score at T_2 for the two surgical wards was associated with a lower nurse–patient ratio (1:6·3 and 1:7·4). This might be explained by increased patient expectations of nurses after patients experienced continuity of care. For the medical ward, a lower nurse–patient ratio in T_1 (1:2·8) also reflected a decline in patient satisfaction score and these scores rose in T_2 (1:3·2) when the nurse–patient ratio increased. Because we

Table 9 Results of patient satisfaction

Ward	Mean ± SD [Range]		
	T0 ($n = 41$)	T1 ($n = 41$)	T2 ($n = 43$)
M1	31·3 ± 12·3 [10–47]	28·6 ± 11·7 [11–44]	31·9 ± 10·8 [17–50]
S1	36·9 ± 6·1 [26–50]	40·4 ± 8·5 [27–50]	34·0 ± 8·6 [15–50]
S2	36·8 ± 11·6 [18–50]	39·6 ± 8·3 [15–50]	35·1 ± 7·1 [21–49]

Phase 0, M1($n = 11$), S1($n = 16$), S2($n = 14$); Phase 1, M1($n = 10$), S1($n = 14$), S2($n = 17$); Phase 2, M1($n = 12$), S1($n = 13$), S2($n = 18$); +, 10 items address both physical and psychosocial needs, score range from 10 to 50.

assumed that an increase in the proportion of direct care was a desired goal for good infection control, this begs the question as to what is the optimal percentage of direct care for patient satisfaction relative to nurse–patient ratio.

Discussion

Modular nursing emphasises total patient care and continuity in attending to the same group of patients unlike conventional task-focused nursing practice. In this study, the modular design did not show a consistent decrease in direct care, but an increase primarily in T_2 vs. T_0. Kovner and Gergen (1998) reported that an increase in an RN's time with patients per day actually reduced urinary tract infections in postoperative care, since time was available for catheter care and ambulation of patients. An increase in the percentage of catheter care in S2, the urology ward, was noted in our study before and after the nurse–patient ratio was adjusted. Needleman *et al.* (2002) also found that an increase in the amount of RN–patient time was related to a decrease in the incidence of nosocomial urinary tract infections. However, we would like to add that, while the decrease in infection was associated with an increase in the percentage of direct care, it might also reflect the relationships that developed with patients, which led to better care. It is clear from focus group interview data that nurses felt more accountable for patients' needs.

Patient/family teaching activities are important aspects of direct care. Capuano *et al.* (2004) reported that the amount of time nurses spent on patient/family teaching activities was negligible despite a higher percentage of direct care. Our findings on patients' satisfaction seem to be consistent with Bekkers *et al.* (1990), that patients in a primary nursing care situation were better informed. The results seem to reflect that patients value helpful nurses who provide them with information and explain their care in a recognizably busy ward. In the same vein, patients may also have higher direct care expectations of nurses, within the context of continuity of care, when the nurse–patient ratio is lower.

Hand washing is considered the essential element of safe patient care in controlling both nosocomial infection in patients and occupationally acquired infection in health care workers. One might speculate that health care workers would be more vigilant in their hand washing since the SARS epidemic. But lapses in hand washing or intention to wash hands are highest when there is a lack of time, in crisis situations and when care is interrupted. Insufficient time to adhere to hand washing recommendations may reflect a nurse's awareness of a hierarchy of patient needs and competing demands when the nurse–patient ratio is high (O'Boyle *et al.* 2001, Kim *et al.* 2003). Therefore, hand washing frequency should increase as more time becomes available to nurses. In our study, there was a general increase in hand washing activities. From nurse interviews, with a relatively predictable patient census and less time pressure, nurses would experience a greater sense of being in control, which would also facilitate nurses' hand hygiene compliance. Nurses' perceived time constraints may lead to poor hand hygiene compliance, which could occur because of pressure from physician requests to immediately remove a wound dressing or when nurses have many wounds to prepare simultaneously. In light of nurses' decreased hand hygiene compliance for this particular procedure, further investigation into its logistics is suggested.

In an acute care setting, nurses seem conditioned to anticipate unexpected workload increases, generally heavy workload, and the need to synchronize routine time/demands, e.g., medication administration time, patient transport times to and from other departments. Therefore, there is a desire to complete the required physical tasks as quickly as possible to cope with the unexpected. Though efficiency is important, the stress here is not so much on individual efficiency, but on team efficiency in the ward.

Geographical separation where nurses cannot cross boundaries to help colleagues is not feasible, given the entrenched values concerning teamwork and the reality of work demands. It is reasonable to believe that it is possible to both render physical assistance and to place heavy emphasis on good hand hygiene practice, while continuity of care remains an important recommendation. Better coordination with admissions would minimize unnecessary transfer, inflow and outflow cases and thereby minimize cross-transmission and improve human resources management. Prescott *et al.* (2004) indicate that nurses have historically completed some non-nursing functions such as transport. Re-examination of the reasons for using nurses for transport and the feasibility of a centralized transport operation is necessary.

Notwithstanding interview responses related to infection control, patient-focused care and efficiency, the fact that nurses at T_0 did not believe that there was a need to change their practice underscores the importance of those that subsequently changed their views to recognize the value of modular nursing. Lundgren *et al.* (2002) asserted that a nurse's 'conception of work precedes and forms the basis for the development of knowledge, skills and attributes used in accomplishing work' (p. 197). If competence rests with nurses' conception of their work, then new competence will lead to an altered conception, which results from their heightened awareness of the value of continuity of care through modular nursing. Nurses' self-reported caring

attributes and competence in all aspects of care in the pre- and postintervention phases might reflect the impact of their altered views. The positive correlation between nurses' caring attributes developed through continuity of care and their sense of competence in care merits further exploration.

Conclusions

While there are limited significant changes between the pre- and postintervention phases, the findings of the study revealed the clinical importance of some changes, as well as general daily nursing care issues. From the changes, it was clear that desirable nurse–patient contact is related to variations in the percentage of direct care. However, this contact may also be related to nurses' consideration of the nature of their activities and attitudes and possibly patient perceptions of nurses' work demands. The clinical importance of continuity of care should be highlighted even in acute settings with a high nurse–patient ratio. The long-entrenched culture of collegiality supports teamwork and ward efficiency, but geographical separation in a general ward setting would not support it. However, nurses' perceived lack of control to anticipate the number of in-flow and out-flow cases could be better managed to minimize the task-oriented approach. Because the process of overcoming nurses' resistance to change with a sense of adjustment and ownership is time consuming, a longer implementation period is needed. Nurses in this study, as in others, indicated the reality of time demands led to hand washing lapses. Thus, the general increase in hand washing activities and nurses' personal time is encouraging. However, the issue of a stable nurse–patient ratio still needs to be addressed to further facilitate the practice of infection control. Ultimately, a supportive environment for nurses' sense of control over work demands is important to professional and personal growth and to humanistic care practices including good infection control.

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Contributions

Study design: EAC, JWYC, TKSW; data collection and analysis: EAC, JWYC, TMFC and manuscript preparation: EAC, TMFC.

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