

University of Wollongong

Research Online

Faculty of Engineering and Information
Sciences - Papers: Part B

Faculty of Engineering and Information
Sciences

2019

Work Pattern of Neurology Nurses in a Chinese Hospital: a Time and Motion Study

Ping Yu

University of Wollongong, ping@uow.edu.au

Liyong Song

Zhejiang University

Siyu Qian

University of Wollongong, sqian@uow.edu.au

X Yao

Huzhou Central Hospital

Jue Huang

Zhejiang University

See next page for additional authors

Follow this and additional works at: <https://ro.uow.edu.au/eispapers1>



Part of the [Engineering Commons](#), and the [Science and Technology Studies Commons](#)

Recommended Citation

Yu, Ping; Song, Liyong; Qian, Siyu; Yao, X; Huang, Jue; Min, Lingtong; Lu, Xudong; Duan, Huilong; and Deng, Ning, "Work Pattern of Neurology Nurses in a Chinese Hospital: a Time and Motion Study" (2019). *Faculty of Engineering and Information Sciences - Papers: Part B*. 2161.

<https://ro.uow.edu.au/eispapers1/2161>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Work Pattern of Neurology Nurses in a Chinese Hospital: a Time and Motion Study

Abstract

Aim: To investigate nursing work patterns in a neurology department in a Chinese hospital. Background: Knowledge of nursing work patterns is important for nursing management and work design, and for the evaluation of organizational process change associated with the introduction of an innovation.

Methods: A time-and-motion method was used to observe 14 registered nurses' (RNs') work patterns in a neurology department in a Chinese hospital. Results: There were 147 hr of observation. Overall, the most time-consuming activities were verbal communication (28.5%) and documentation (28.3%), followed by indirect care (14.6%) and direct care (14%). Compared to support RNs, charge RNs spent 20% more time on documentation and 11% more time on verbal communication. Two-thirds of the observed activities had a duration of less than 40 s.

Conclusions: Communication, in verbal and written forms, consumed more than half of the nursing time. Conversely, nurses only spent about a quarter of their worktime on preparation for care provision and direct care provision. This reflects the significant role and resource-consuming nature of communication to provide safe and quality care.

Implications for Nursing Management: Communication methods need to be enhanced to improve nursing productivity. This may be achieved through the introduction of more effective nursing documentation methods.

Disciplines

Engineering | Science and Technology Studies

Publication Details

Yu, P., Song, L., Qian, S., Yao, X., Huang, J., Min, L., Lu, X., Duan, H. & Deng, N. (2019). Work Pattern of Neurology Nurses in a Chinese Hospital: a Time and Motion Study. *Journal of Nursing Management*, 27(2), 320-329.

Authors

Ping Yu, Liying Song, Siyu Qian, X Yao, Jue Huang, Lingtong Min, Xudong Lu, Huilong Duan, and Ning Deng

1 **Work Pattern of Neurology Nurses in a Chinese Hospital: a Time and Motion Study**

2 **Abstract**

3 *Aim* To investigate nursing work pattern in a neurology department in a Chinese hospital.

4 *Background* Knowledge of nursing work pattern is important for nursing management and
5 work design, and evaluation of organizational process change associated with the
6 introduction of an innovation.

7 *Methods* Time and motion method was used to observe 14 registered nurses' (RNs) work
8 pattern in a neurology department in a Chinese hospital.

9 *Results* 147 hours of observation were conducted. Overall, the most time-consuming activity
10 was verbal communication (28.5%) and documentation (28.3%) followed by indirect care
11 (14.6%) and direct care (14%). Compared to Support RN, Charge RN spent 20% more time
12 on documentation and 11% more time on verbal communication. Two thirds of the observed
13 activities had duration less than 40 seconds.

14 *Conclusions* Communication, in verbal and written format, consumed more than half of
15 nursing time. Conversely nurses only spent about a quarter of their worktime on preparation
16 for and direct care provision. This reflects the significant role and resource-consuming nature
17 of communication to provide safe and quality care.

18 *Implications for Nursing Management* Communication methods need to be improved so as to
19 improve nursing productivity. This may be achieved through the introduction of more

1 effective nursing documentation method.

2 Key words: nurse, nursing work, activity, hospital, neurology, time and motion, observation

1 **Introduction**

2 Knowledge of nursing work pattern is important for nursing work design, resource allocation,
3 staff performance appraisal (Qian, Yu, Zhang, Hailey, Davy & Nelson, 2012), identification
4 of areas needing improvement (Cornell, Herrin-Griffith, Keim, Petschonek, Sanders, D'Mello,
5 Golden & Shepherd, 2010), and evaluation of organizational process change associated with
6 the introduction of an innovation (Guo, Watts & Wharrad, 2015). Nursing work pattern can
7 be identified from the daily activities of a representative sample of nurses in a nursing unit,
8 such as the amount of time, duration and frequency of an activity, as well as the sequence of
9 activities. The amount of time nurses spend with patients is associated with quality and safety
10 of care (Cho, Lee, Kim, Kim, Lee, Park & Sung, 2016) and patient satisfaction (Hockenberry
11 & Becker, 2016). It also links to the nurses' job satisfaction, which is critical for nurse
12 retention (Hayes, Bonner & Pryor, 2010).

13 The work pattern measurement in healthcare settings is usually conducted with three
14 techniques: self-reporting daily logs, observation with work sampling method and time and
15 motion observational study. Self-reporting daily logs ask individuals to record their activities
16 at frequent intervals. Although this method can capture the tasks being performed, the
17 accuracy of reporting suffers from subjectivity of perceptions and recall error, let alone lapse
18 in rush hours (Ampt, Westbrook, Creswick & Mallock, 2007).

19 Work sampling technique has been developed to capture workers' activities. This method
20 measures the activity of a group of individuals (Pelletier & Duffield, 2003). Its advantage is
21 to allow a single observer to record all the activities conducted by all the study subjects

1 during a period of time. As it is well-planned and objectively conducted by a trained
2 researcher, it is usually more accurate than self-reporting logs. However, in this method the
3 time expenditure of an activity was estimated instead of counting the actual time. This may
4 not be accurate. It may also cause loss of certain useful information such as the interaction
5 among nurses or between nurses and patients.

6 In a time and motion study, an observer measures and records every activity performed by a
7 healthcare worker and the exact amount of time the person spends on the activity (Qian et al.,
8 2012). Thus it is able to provide an accurate recording of the amount of time, duration and
9 frequency of an activity, as well as the sequence of activities.

10 Although nursing time studies can be dated back to 1950s (Abdellah & Levine, 1954) and
11 have been conducted in many countries over the decades (Williamson Jr & Johnston, 1988,
12 Urden & Roode, 1997, Williams, Harris & Turner-Stokes, 2009, Antinaho, Kivinen, Turunen
13 & Partanen, 2014), to our knowledge, there has been no report on nursing work pattern and
14 time expenditure in hospitals in mainland China. This knowledge is vital for enriching and
15 advancing the field of international nursing management and leadership. Therefore, this study
16 aimed to empirically investigate the work patterns of nurses in a Chinese hospital using the
17 time and motion observation method.

18 **Methods**

19 *Study setting*

20 According to the Management Standards of Hospital Classification used by the Ministry of

1 Health in China, hospitals are classified into three grades according to its number of beds.
2 Hospitals with no more than 100 beds are in Grade 1, those with 100 to 500 beds are in Grade
3 2, and those with more than 500 beds are in Grade 3. In each grade, there are three classes; A,
4 B and C. The criterion for a Class 3A hospital is achieving 900 out of 1000 points in hospital
5 accreditation. The main aspects of accreditation assessment include systems and management,
6 medical service quality and safety, and the level of technology usage and efficiency.

7 There were, in total, 776 Class 3A hospitals in China in 2015. As hospitals in this grade
8 provide the highest quality of services, the nursing services in these hospitals are the model
9 services for the hospitals in lower grades in China. Therefore, to maximize the value of the
10 study to provide insight and exemplary outcomes for hospitals in the same and lower grades
11 to learn and improve their management, we chose a Class 3A hospital to conduct this study.

12 The Huzhou General Hospital is a teaching hospital affiliated with Zhejiang University. It is
13 located in Huzhou, Zhejiang Province, China. It had 1,200 beds in 34 wards and an intensive
14 care unit. The observation was conducted in the Neurology Department because this
15 department was selected as the test site to implement a PDA-enabled electronic medication
16 management system in the hospital. To establish a baseline for the evaluation of the impact of
17 the innovation, the baseline data need to be collected.

18 The department had 40 beds, 36 were occupied during the study period. The top five common
19 diseases treated in the unit were cerebrovascular disease, epilepsy, Parkinson's disease,
20 primary headache and vestibular peripheral vertigo. Except two patients who needed to be
21 observed every 15 to 30 minutes, the rest 34 patients were stable, could conduct light

1 activities in bed or indoor. They required nursing observation every one to two hours.

2 *Staffing*

3 The Neurology Department was staffed by 16 registered nurses (RNs), each had at least
4 three-year university education. On a working day, a nurse might be in charge (Charge RN)
5 or in support (Support RN) role. The difference between these two types of RNs was a
6 Charge RN had clear caring responsibility for patients allocated to her; whereas the Support
7 RN was “floating” around to provide helping hands to the Charge RN when the later was
8 fully occupied to respond to further duty.

9 In a day shift from 8 am to 8 pm, four Charge RNs and three Support RNs provided nursing
10 care to 36 patients. All Charge RNs worked from 8 am to 5 pm. One Support RN worked
11 from 7:45 am to 3:45 pm, another worked from 12 pm to 8 pm, and the third worked from 8
12 am to 12 pm and then from 5 pm to 8 pm. Therefore, the nurse-to-patient ratio was 1:6 from 8
13 am to 5 pm, and reduced to 1:18 after 5 pm.

14 *Ethical considerations*

15 Ethical approval was granted by the ethics committee of the participant hospital based on the
16 written approval given by the university and the approval by the Head Nurse in the hospital.
17 The observer was introduced to the nursing staff by the Director of Nursing (DON) in the
18 Neurology Department.

19 To ensure that the nurses’ participation in the study was completely voluntary, the researchers
20 informed the nurses that the study was independent from hospital operation and participation

1 in it was completely voluntary. Nurses could choose to refuse to participate or withdraw their
2 data from the study at any time and their refusal or withdrawal of data would not affect any
3 relationship that they had with the unit, the hospital or the university. It was also made
4 explicit that the research data collected from them would be stored securely in the password
5 protected computers of the researchers and were only accessible by the researchers. On each
6 observation day, the observer re-iterated the study purpose and procedure, and the voluntary
7 nature of participation. Only after explicit written consent was acquired from the person, was
8 observation of the person's activities permitted to begin.

9 *Classification of nursing activities*

10 A four-step process was followed for the development of the classification system of nursing
11 activities: 1) identification of nursing activities and their classifications from the literature, 2)
12 field observation to identify nursing activities specific to the study setting, 3) validation of
13 nursing activities by unit nurses and 4) field testing the validity of the classification system.

14 In the first phase, hospital nursing activities, their definitions and classifications were
15 identified from the literature (Capuano, Bokovoy, Halkins & Hitchings, 2004, Chaboyer,
16 Wallis, Duffield, Courtney, Seaton, Holzhauser, Schluter & Bost, 2008, Hendrich, Chow,
17 Skierczynski & Lu, 2008, Lee, Mills & Lu, 2008, Williams et al., 2009, Abbey, Chaboyer &
18 Mitchell, 2012, Antinaho et al., 2014).

19 In the second phase, the observer observed two Charge RNs from 8 am to 5 pm on two
20 separate days. She recorded all activities conducted by each RN in the whole shift. Brief
21 communication with the RNs was conducted to clarify the nature of an activity whenever it

1 was needed.

2 In the third phase, nursing activities identified from the literature and those directly observed
3 in the field were synthesized. The DON and two nurses reviewed, discussed and revised the
4 list. This resulted in 67 activities grouped into eight categories: direct care, indirect care,
5 infection control, documentation, staff break, transit, verbal communication and other
6 activities (Table 1). The definitions of direct care and indirect care were adopted from the
7 previous studies (Pelletier et al., 2003, Williams et al., 2009). Direct care is “nursing care
8 activities performed in the presence of the patient and/or family”. Indirect care is “nursing
9 care activities performed away from the patient, but on a specific patient’s behalf”. Three
10 important nursing activities - verbal communication, documentation and infection control –
11 were initially included in the categories of direct care and indirect care. In order to acquire
12 enough granularity, we separated these three activities into independent categories of their
13 own, differentiating them from those of direct care and indirect care.

14 In the last phase, the classification system was validated in a two-day observation with a
15 participant nurse who had extensive experience in nursing practice. The observer and the
16 nurse independently observed the same activities. Then the two discussed the similarities and
17 differences of their records. The results suggested that the classification system was valid in
18 representing the nursing activities in the unit.

19 Insert Table 1 about here

1 *Study participants*

2 Fourteen out of 16 (86.5% of) nurses working in the unit were observed. There were nine
3 Charge RNs and five Support RNs. Due to the availability of nurses at duty during the
4 observational period, two Charge RNs and one Support RN were observed twice. The rest 11
5 nurses were observed once each. Therefore, the nursing activities in the unit were adequately
6 captured.

7 *Sample size*

8 The number of participants observed was confined by the actual number of nurses working in
9 the study unit and the availability of the observer. The unit of analysis, however, was the
10 activity, rather than individual nurses, so the sample size was determined as the total number
11 of activities to be recorded. Using the statistical power calculation formula suggested by
12 Sittig (Sittig, 1993) and data collected from the pilot observation, it was determined that the
13 total number of activities needed to be observed was 1,824 and 1,411 for Charge RN and
14 Support RN, respectively. In the formal data collection, 5,368 and 2,549 activities were
15 recorded for the two types of nurses, respectively, larger than the estimated sample size.

16 *Field data collection*

17 Data collection was carried out over a period of 17 days in 2014. The convenience sampling
18 approach was used to select one nurse to observe on each day. An Excel spreadsheet with a
19 pre-entered classification system of activities on a handheld tablet computer was used to
20 record nursing activities. To enable fast recording, only the end time was recorded for an

1 observed activity because the end time of the current activity was the start time of the next
2 one. When a nurse spoke and performed another activity concurrently, the observer recorded
3 both the start and the end time of this verbal communication activity. Other information
4 recorded included date and period of observation and the job role of the nurse.

5 *Data analysis*

6 The data was entered into an Excel spreadsheet and imported to SPSS 19.0 (SPSS Inc.,
7 Chicago, IL, USA) for analysis of activity time, frequency and duration. A z test was used to
8 compare the percentage of time spent on each category of activities between the two types of
9 nurses. A statistically significant difference was assumed when the p value was less than 0.05.

10 **Results**

11 All of the designated 67 activities were observed. Fourteen nurses were observed for a period
12 of 17 days, a total of 147.2 hours of observation. 7,917 activities were recorded, 5,368 for
13 Charge RN and 2,549 for Support RN. Nursing work pattern in the Neurology Department in
14 Huzhou General Hospital was presented below in terms of nursing time on different
15 categories of activities, activity frequency and duration, and sequence of activities.

16 *Activity time*

17 Figure 1 shows the nursing time spent on each category of activities. The percentage did not
18 necessarily add up to 100% because verbal communication may occur either by itself or
19 simultaneously with another activity; thus overlapping with that activity.

1 Nurses spent 28.5% (95% confidence interval [CI]: 23.9-33%) of their time on verbal
2 communication, with 8.8% of this communication time concurrently spent on doing another
3 activity. The second most time-consuming activity was documentation (28.3%, 95% CI:
4 21.9-34.8%). This was followed by indirect care (14.6%, 95% CI: 8.9-20.2%), direct care
5 (14.0%, 95% CI: 11.8-16.1%), staff break (8.8%, 95% CI: 5.2-12.3%), transit (8.2%, 95% CI:
6 6.5-9.9%), infection control (3.6%, 95% CI: 2.7-4.5%) and other activities (2.8%, 95% CI:
7 1.1-4.5%).

8 Insert Figure 1 about here

9 The most time-consuming direct care activity was ‘intravenous infusion’ at about 28 minutes
10 per eight-hour shift. This was followed by ‘changing or withdrawing intravenous medication’
11 at about 10 minutes over an eight-hour shift. The most time-consuming indirect care activity
12 was ‘preparing medications according to prescriptions’ at about 20 minutes.

13 Figure 2 presents the time, frequency and duration by activity category for each type of nurse.
14 Charge RN spent significantly less time than Support RN on ‘indirect care’ (8.2% vs. 26.2%,
15 $p<0.0001$), ‘staff break’ (6.9% vs. 12.3%, $p<0.01$), and ‘transit’ (6.5% vs. 11.3%, $p<0.0001$).
16 In a sharp contrast with Support RN, Charge RN spent more time on ‘documentation’ (35.5%
17 vs. 15.3%, $p<0.0001$) and ‘verbal communication’ (32.5% vs. 21.1%, $p<0.001$).

18 Insert Figure 2 about here

19 No statistically significant difference between the two types of nurses was found in their time
20 spent on ‘direct care’, ‘infection control’ and ‘others’; and these activities took approximately

1 20.4% of their working time.

2 *Activity frequency and duration*

3 For Charge RN, the most frequently conducted activity was verbal communication, followed
4 by transit and documentation (Figure 2). For Support RN, however, the most frequently
5 conducted activity was transit, indirect care and direct care.

6 Activity duration was short and varied dramatically (Figure 2). For Charge RN, the average
7 durations of direct care, infection control and documentation were longer than one minute,
8 whereas the average duration of indirect care and verbal communication were less than one
9 minute. There was a similar pattern for the Support RN, except for indirect care which has a
10 longer duration than that of the Charge RN.

11 Figure 3 shows the distribution of durations of activities. Of the 7,917 activities recorded,
12 22.5% were completed in less than 10 seconds, and 23.3% took between 10 and 19 seconds.
13 Overall, about two-thirds of the observed activities in the ward had a very short
14 duration—less than 40 seconds.

15 Insert Figure 3 about here

16 *Sequence of activities*

17 Figure 4 depicts the pattern of nursing activity sequence. The eight activity categories are
18 presented as nodes. A directed edge between two nodes represents a switch from one activity
19 to another. The thickness of an edge represents the level of frequency of the switch. The

1 thicker the edge, the more frequent a switch occurred.

2 Insert Figure 4 about here

3 On average, 61.3 switches between two consecutive activities were observed in an hour, one
4 per minute. The directions of the most frequently observed switches were within or between
5 verbal communication, direct care, transit and documentation by Charge RN. As to Support
6 RN, the most frequent switches were within or between indirect care, transit and direct care.

7 **Discussion**

8 For the first time, this study investigated the nursing work pattern in a Neurology Department
9 in a Chinese tertiary hospital. This included the actual nursing time spent on an activity, the
10 frequencies, durations and sequence of activities over a twelve-hour shift.

11 The nursing activity classification system developed in our study includes 67 distinctive
12 nursing activities. This high level of granularity facilitates accurate identification and
13 recording of nursing activities in field observations. It is useful for nursing work redesign,
14 hospital unit organization, and evaluation of change in nursing work following the
15 introduction of new innovations e.g. mobile nursing documentation system into nursing work.

16 Compare to other classifications of hospital RNs' activities (see Table 2), our classification
17 distinguishes communication, transit and infection control (e.g. washing hands) from the
18 others so as to highlight the resource of nursing time required for these activities.

19 Insert Table 2 about here

1 Documentation accounts for 28% of nurses' time in this study, which is similar to 27.5%
2 found from 767 nurses across 36 US hospitals (Hendrich et al., 2008) but higher than 16%
3 and 13% found in a Finnish hospital (Antinaho et al., 2014) and a US hospital (Capuano et al.
4 2004), respectively. This suggests that nursing workload in documentation may vary a lot in
5 different health systems in different countries. In addition to the difference in professional
6 practice, the other possible factors that contribute to the differences in documentation
7 workload may include documentation policy in a hospital, legal requirements for nursing
8 documentation in different countries and documentation tools used.

9 Support RN spent significantly more time on indirect care and transit than Charge RN, but
10 less time on documentation and verbal communication. These differences clearly show the
11 difference in the duties and responsibilities between the two nursing roles. Support RN
12 performed more indirect care activities as requested by Charge RN, consequently transiting
13 more.

14 Compared to Support RN, Charge RN spent significantly less time on staff break but 20%
15 more time on documentation and 11% more on verbal communication. This may be because
16 in order to fulfil the responsibility of patient care, the Charge RN had to take longer time,
17 sometimes overtime, to complete the verbal and written communication at the cost of
18 reducing own break time.

19 It is interesting to note that both types of nurses spent the same amount of time on direct care
20 (14%). This might be because that the two types of nurses always conducted direct care
21 activities together.

1 Like the study which examined the work pattern of nurses in two medical-surgical units of a
2 US hospital (Cornell et al., 2010), we also found that sequence of nursing activities seemed to
3 be chaotic with frequent switches between activities. Cornell et al. (2010) found more than 40%
4 of activities had a duration of less than 10 seconds, about twice of those (22.5%) found in our
5 study. In fact, we found that 23.3% of nursing activities had a duration of 10 to 20 seconds.
6 Both studies expose the busy nature of hospital nursing care, which requires nurses to
7 constantly switch among activities fairly rapidly. This can be a source of nursing stress and
8 burnout.

9 *Limitations*

10 One of the limitations was the small number of nurses observed, limited by the total number
11 of nurses working in the department and the availability of the observer. The number of
12 participants observed, however, accounted for 87.5% (14/16) of all nurses working in the
13 study setting, validly representing nursing activities in the study unit. Although patient
14 disease severity can be a key factor to account for nursing management (Buffel du Vaure,
15 Ravaud, Baron, Gilberg & Boutron, 2016) and workload (Kraljic, Zuvic, Desa, Blagaic,
16 Sotosek, Antoncic & Likic, 2017), the conditions of most patients in the study unit were
17 similarly stable, thus it is not possible for us to identify the relationship between patients'
18 disease severity and nursing work arrangement in this natural setting.

19 The benefit of using a single observer is to ensure consistency of activity recording but this
20 can cause systematic errors in observation. This potential limitation was addressed by a pilot
21 observation with a nurse to validate the observation, followed by a two-day observation

1 conducted by two observers to test the intra-rater reliability, which was satisfactory.

2 We made an effort to minimise the Hawthorne effect, i.e. the influence of the observer on
3 nurses' behaviour (Westbrook & Ampt, 2009). As found in the previous studies (Schnelle,
4 Ouslander & Simmons, 2006, Ampt et al., 2007, Westbrook et al., 2009, Munyisia, Yu &
5 Hailey, 2011), we noticed that in the busy hospital healthcare environment, the Hawthorne
6 effect caused by direct observation was not significant because the nurses had to concentrate
7 on nursing activities and quickly ignore the presence of the observer.

8 **Conclusion**

9 This study investigates the nursing work pattern and time expenditure in a neurology
10 department in a Chinese hospital. Verbal communication, documentation, direct care and
11 indirect care consumed majority of nursing time. The short activity duration and frequent
12 switches between activities depict a busy nursing work in meeting the diverse demands of
13 patient care. Charge RN spent more time on documentation and verbal communication but
14 less time on indirect care and transit than the Support RN. Both categories of nurses spent the
15 same amount of time on direct care.

16 **Implications for nursing management**

17 Although there were some studies investigating how nurses spent their time in hospital
18 settings in some countries, little is known about the situation in Chinese hospitals. This case
19 study contributes to knowledge about nursing work pattern and time expenditure in a
20 neurology department in a Chinese hospital.

1 The results indicate that for the optimal delivery of nursing care, verbal communication and
2 documentation are equally important. Therefore, improving nurse's verbal communication
3 and documentation skills is an important component for the improvement of quality of
4 hospital nursing care.

5 Knowledge of nursing work pattern and time expenditure can help nursing managers to
6 evaluate the impact of future improvement effort. It is vital for enriching and advancing the
7 field of international nursing management and leadership.

8 **References**

- 9 Abbey, M., Chaboyer, W. & Mitchell, M. (2012). Understanding the work of intensive care nurses: A time and
10 motion study. *Aust Crit Care*, 25 (1), 13-22.
- 11 Abdellah, F.G. & Levine, E. (1954). Work sampling applied to the study of nursing personnel. *Nursing Research*,
12 3 (1), 11-16.
- 13 Ampt, A., Westbrook, J., Creswick, N. & Mallock, N. (2007). A comparison of self-reported and observational
14 work sampling techniques for measuring time in nursing tasks. *J Health Serv Res Policy*, 12 (1), 18-24.
- 15 Antinaho, T., Kivinen, T., Turunen, H. & Partanen, P. (2014). Nurses' working time use - how value adding it is?
16 *Journal of Nursing Management*, 3 (10), 12258.
- 17 Blay, N., Duffield, C.M., Gallagher, R. & Roche, M. (2014). Methodological integrative review of the work
18 sampling technique used in nursing workload research. *Journal of Advanced Nursing*, 70 (11),
19 2434-2449.
- 20 Buffel du Vaure, C., Ravaud, P., Baron, G.B., C., Gilberg, S. & Boutron, I. (2016). Potential workload in
21 applying clinical practice guidelines for patients with chronic conditions and multimorbidity: A
22 systematic analysis. *BMJ Open*, 6 (3), e010119.
- 23 Capuano, T., Bokovoy, J., Halkins, D. & Hitchings, K. (2004). Work flow analysis: Eliminating
24 non-value-added work. *Journal of Nursing Administration*, 34 (5), 246-256.
- 25 Chaboyer, W., Wallis, M., Duffield, C., Courtney, M., Seaton, P., Holzhauser, K., Schluter, J. & Bost, N. (2008).
26 A comparison of activities undertaken by enrolled and registered nurses on medical wards in australia:
27 An observational study. *International journal of nursing studies*, 45 (9), 1274-1284.
- 28 Cho, E., Lee, N.-J., Kim, E.-Y., Kim, S., Lee, K., Park, K.-O. & Sung, Y.H. (2016). Nurse staffing level and
29 overtime associated with patient safety, quality of care, and care left undone in hospitals: A
30 cross-sectional study. *International Journal of Nursing Studies*, 60, 263-271.
- 31 Cornell, P., Herrin-Griffith, D., Keim, C., Petschonek, S., Sanders, A.M., D'Mello, S., Golden, T.W. & Shepherd,
32 G. (2010). Transforming nursing workflow, part 1: The chaotic nature of nurse activities. *J Nurs Adm*
33 40 (9), 366-373.
- 34 Guo, P., Watts, K. & Wharrad, H. (2015). An integrative review of the impact of mobile technologies used by
35 healthcare professionals to support education and practice. *Nursing Open*.

- 1 Hayes, B., Bonner, A. & Pryor, J. (2010). Factors contributing to nurse job satisfaction in the acute hospital
2 setting: A review of recent literature. *Journal of Nursing Management*, 18 (7), 804-814.
- 3 Hendrich, A., Chow, M.P., Skierczynski, B.A. & Lu, Z. (2008). A 36-hospital time and motion study: How do
4 medical-surgical nurses spend their time? *The Permanente Journal*, 12 (3), 25.
- 5 Hockenberry, J.M. & Becker, E.R. (2016). How do hospital nurse staffing strategies affect patient satisfaction?
6 *ILR Review*, 0019793916642760.
- 7 Kraljic, S., Zuvic, M., Desa, K., Blagaic, A., Sotosek, V., Antoncic, D. & Likic, R. (2017). Evaluation of nurses'
8 workload in intensive care unit of a tertiary care university hospital in relation to the patients' severity
9 of illness: A prospective study. *International Journal of Nursing Studies*, 76, 100-105.
- 10 Lee, T.T., Mills, M.E. & Lu, M.H. (2008). Impact of a nursing information system on practice patterns in taiwan.
11 *Computers Informatics Nursing*, 26 (4), 207-214.
- 12 Munyisia, E.N., Yu, P. & Hailey, D. (2011). How nursing staff spend their time on activities in a nursing home:
13 An observational study. *Journal of Advanced Nursing*, 67 (9), 1908-1917.
- 14 Pelletier, D. & Duffield, C. (2003). Work sampling: Valuable methodology to define nursing practice patterns.
15 *Nursing & Health Sciences*, 2003 (5), 31-38.
- 16 Qian, S., Yu, P., Zhang, Z., Hailey, D., Davy, P. & Nelson, M. (2012). The work pattern of personal care workers
17 in two australian nursing homes: A time-motion study. *BMC Health Services Research*, 12 (1), 305.
- 18 Schnelle, J.F., Ouslander, J.G. & Simmons, S.F. (2006). Direct observations of nursing home care quality: Does
19 care change when observed? *J Am Med Dir Assoc*, 7 (9), 541-544.
- 20 Sittig, D.F. (1993). Work sampling: A statistical approach to evaluation of the effects of computers on work
21 patterns in health care. *Methods of Information in Medicine*, 32 (2), 167-174.
- 22 Urden, L.D. & Roode, J.I. (1997). Work sampling. A decision-making tool for determining resources and work
23 redesign. *J Nurs Adm* 27 (9), 34-41.
- 24 Westbrook, J.I. & Ampt, A. (2009). Design, application and testing of the work observation method by activity
25 timing (wombat) to measure clinicians' patterns of work and communication. *Int J Med Inform*, 78
26 *Suppl 1*, S25-S33.
- 27 Williams, H., Harris, R. & Turner-Stokes, L. (2009). Work sampling: A quantitative analysis of nursing activity
28 in a neuro-rehabilitation setting. *Journal of Advanced Nursing*, 65 (10), 2097-2107.
- 29 Williamson Jr, W.J. & Johnston, J. (1988). Understanding, evaluating and improving nursing productivity. *Nurs*
30 *Manage*, 19 (5), 49-50, 52, 54.

31

1 **Table 1. Classification of nursing work activities.**

Categories	Activities	
Direct care	Allocating beds to patients	
	Measuring a patient's vital signs	
	Ward round (checking and assessing patients' condition)	
	Basic care (e.g. oral care, perineal care, pressure ulcer care)	
	Activities of daily living (e.g. toileting, dressing, turning a patient in bed)	
	Preparing a patient for tests (e.g. transferring a patient from a bed to a wheelchair or a movable bed, taking off metal things from a patient)	
	Collecting specimens (e.g. urine collection, blood collection)	
	Rehabilitation training for a patient	
	Distributing test results to patients	
	Adjusting drip rate	
	Administering oral medications	
	Intravenous infusion	
	Checking patients during intravenous infusion	
	Changing or withdrawing intravenous medication	
	Administering medications via nasogastric tube feeding	
	Administering medications (excluding oral medication and intravenous infusion) such as a nebulizer	
	Indirect care	Managing ward environment (e.g. putting intravenous stands, adjusting bed height)
		Sorting out cabinets for storing gauze, adhesive tape etc.
Disposal of clinical waste		
Maintenance and use of medical equipment		
Pasting barcodes to containers for specimen collection		
Counting and replenishing supplies and medications		
Checking medications including both long-term and short-term oral medications and intravenous medications		
Pasting labels to a patient's medications and putting the medications in the person's compartment		
Re-checking information about a patient and his or her medications (this activity is done by a nurse different from the nurse who prepares medications)		
Preparing medications according to prescriptions		
Preparing equipment for intravenous infusion (e.g. putting prepared medications, cotton swab, adhesive tape, infusion set on a plate in the medication trolley)		
Infection control	Putting on personal protective equipment	
	Taking off personal protective equipment	
	Washing hand with water	
	Washing hand with hand sanitizer	

Documentation	Filling out an infusion card
	Filling out a paper-based admission form et al.
	Reading information on a desktop computer
	Batch recording and reviewing the vital signs of patients on desktop computers
	Entering admission data on a desktop computer
	Recording nursing care on a computer
	Reviewing nursing records on a computer
	Recording information about patients using a piece of paper
	Reviewing and entering prescriptions on a computer
	Printing paper records (e.g. infusion cards and barcodes)
	Sorting paper records
	Checking paper-based prescriptions
	Checking information on paper-based records against electronic medical orders of the week with another one or two nurses
	Sorting test results and consultation sheets
	Preparing discharge advice of a doctor (e.g. reviewing handwritten information from a doctor)
	Filling out and checking discharge records on a desktop computer
	Printing discharge records
	Filling out paper-based discharge registers
	Filling out and sorting paper records of discharged patients
	Entering fees on a desktop computer
	Filling out an application form for new supplies on a desktop computer
	Registering paper-based inventory
	Scanning barcodes and sending specimens for tests
Sorting infusion cards after intravenous infusion	
Staff break	Personal errands (off unit chores; meal break; making personal telephone call).
Transit	Standing or walking in the corridor between activities
Verbal communication	Training student nurses
	Seeking help from another nurse
	Assisting another nurse with his or her work
	Participating in on-job training
	Communicating with others about a patient information (e.g. nursing assistants transporting specimens)
	Communicating with other nurses about a patient information
	Communicating with doctors about a patient information
	Communicating with patients and their family members
Receiving or making a phone call	
Others	Other tasks not included

Table 2. Comparison of hospital RNs' activities and time expenditure.

Study	Our study	(Antinaho et al., 2014)	(Abbey et al., 2012)	(Williams et al., 2009)	(Chaboyer et al., 2008)	(Hendrich et al., 2008)	(Lee et al., 2008)	(Capuano et al., 2004)
Country	China	Finland	Australia	UK	Australia	US	China	US
Setting	Neurology Department	Internal medicine units; surgical units; psychiatric units	Intensive care unit	Neurological rehabilitation unit	Medical wards	Medical surgical units	General surgical units	Neuroscience medical surgical unit
NO. of observed activities	67	39	25	23	25	14	83	17
Observation method	time-motion	self-report	time-motion	work sampling	work sampling	self-report time-motion	work sampling	work sampling
Direct care	14%	38% (incl.10% communication)	40.5%	37% (incl.3.4% communication)	18-34.8% (incl. 4-5.31% communication)	50.2% Nursing practice	20%	44%
Indirect care	14.6%	17% (incl.2% communication)	32.4%	37% (incl.19.9% communication)	45.5-59.7% (incl.10.1-17.1% communication)		25%	21.8%
Documentation	28.3%	16%	-	-	-	27.5%	30%	13.2%
Other categories specific to a study	-3.6% infection control -8.2% transit -28.5% communication (8.8% concurrently spent on doing another activity) -8.8% staff break -2.8% others	-5% indirect work (e.g. organising outpatient care) -9% unit-related (e.g. in-service education) -7% personal time -8% miscellaneous work (e.g. waiting, cleaning)	-5% unit-related (e.g. in-service education, clerical, meetings) -21.9% personal time	-10% unit-related (e.g. replenishing supplies, unit meetings) -16% personal time (e.g. education, training, continuous professional development, meal breaks)	-5.6-10.1% unit-related -12.1-13.7% personal time	-2.8% unit-related -12.6% non-clinical (e.g. personal, patient/family care) -6.6% waste (hunting or gathering activities)	-9% unit-related -15% personal time	-6.9% unit-related -13.8% personal time

Figure legend

Figure 1. Percentage of nursing time spent on each category of activities.

Figure 2. Activity time, frequency and duration of Charge RN and Support RN.

Figure 3. Distribution of durations of nursing activities.

Figure 4. Switches between activities.

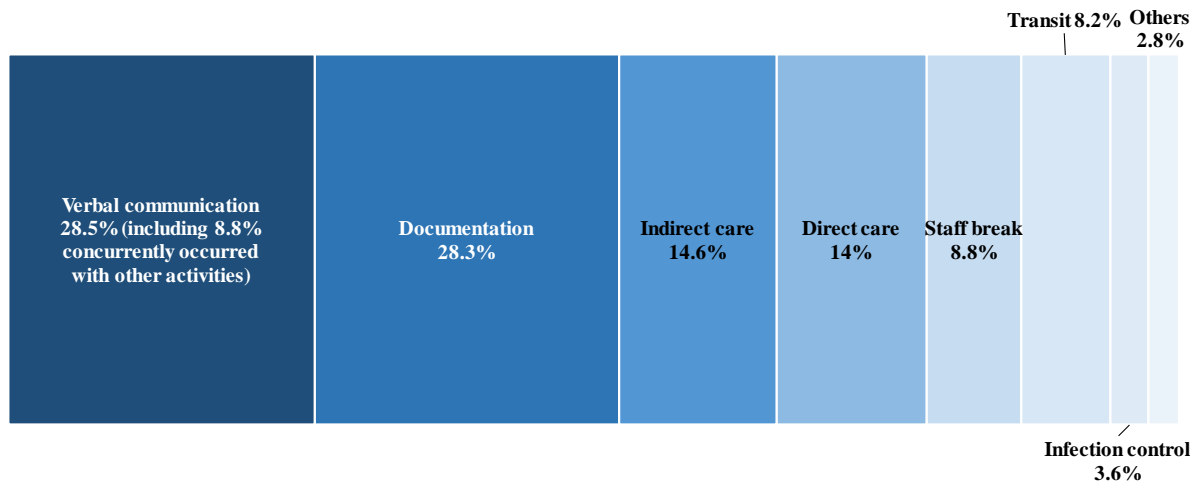


Figure 1. Percentage of nursing time spent on each category of activities.

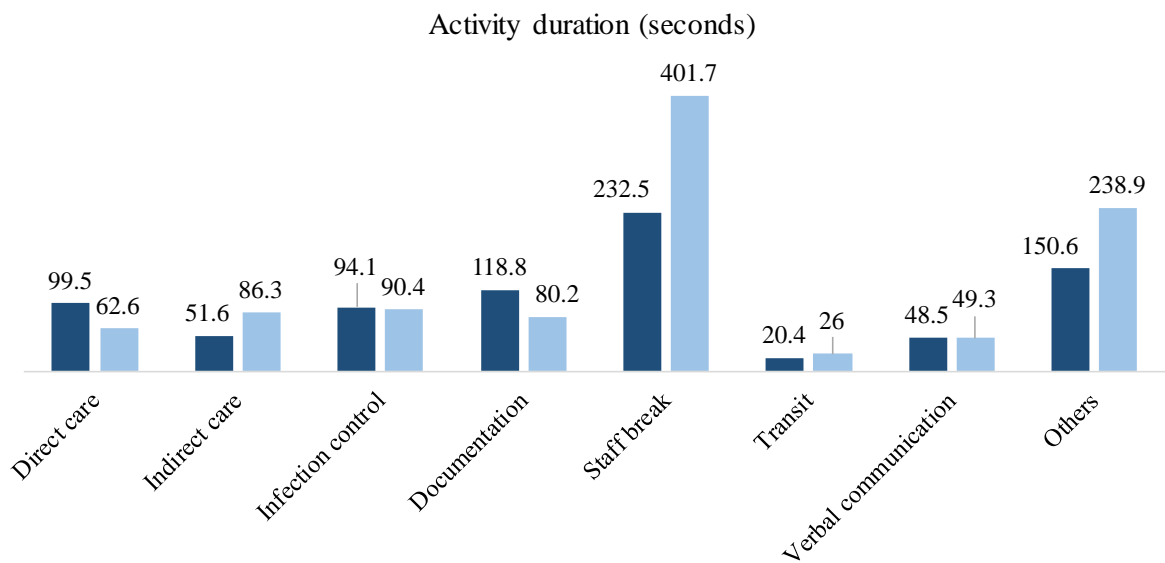
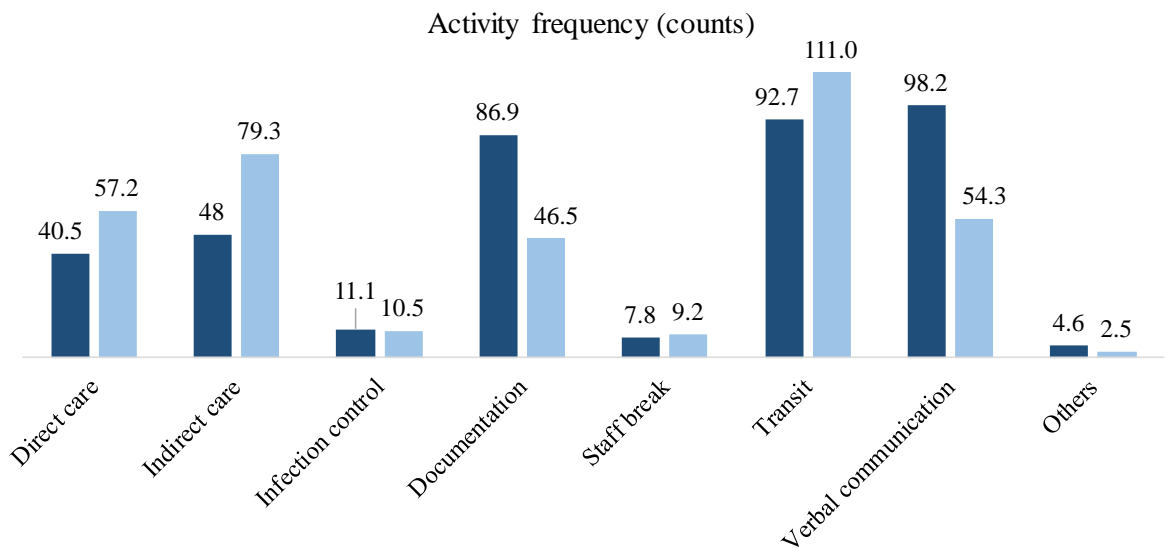
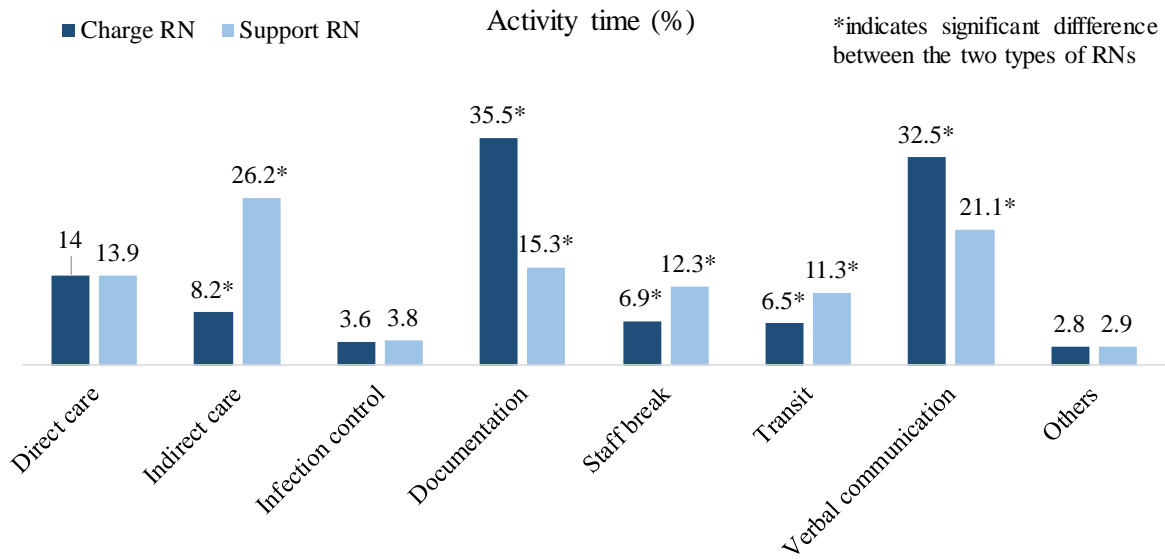


Figure 2. Activity time, frequency and duration of Charge RN and Support RN.

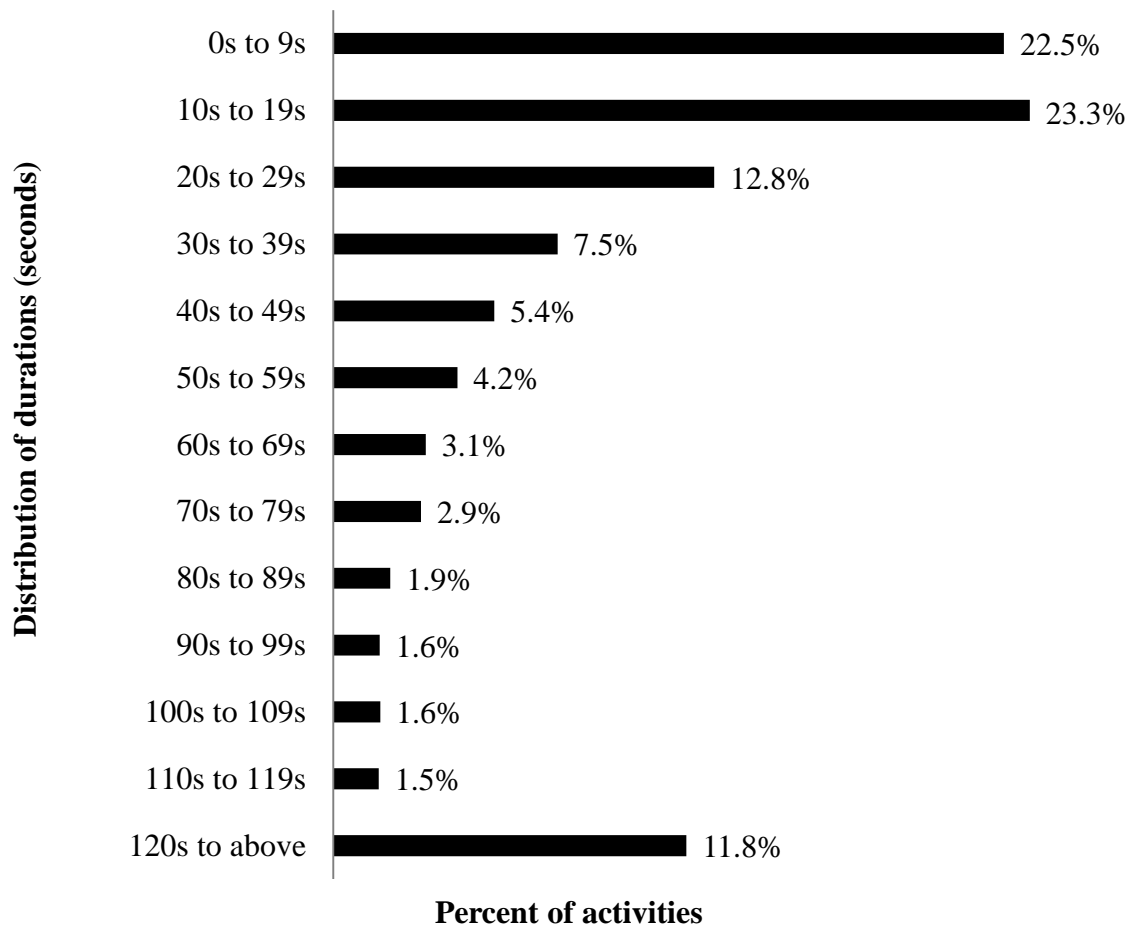


Figure 3. Distribution of durations of nursing activities.

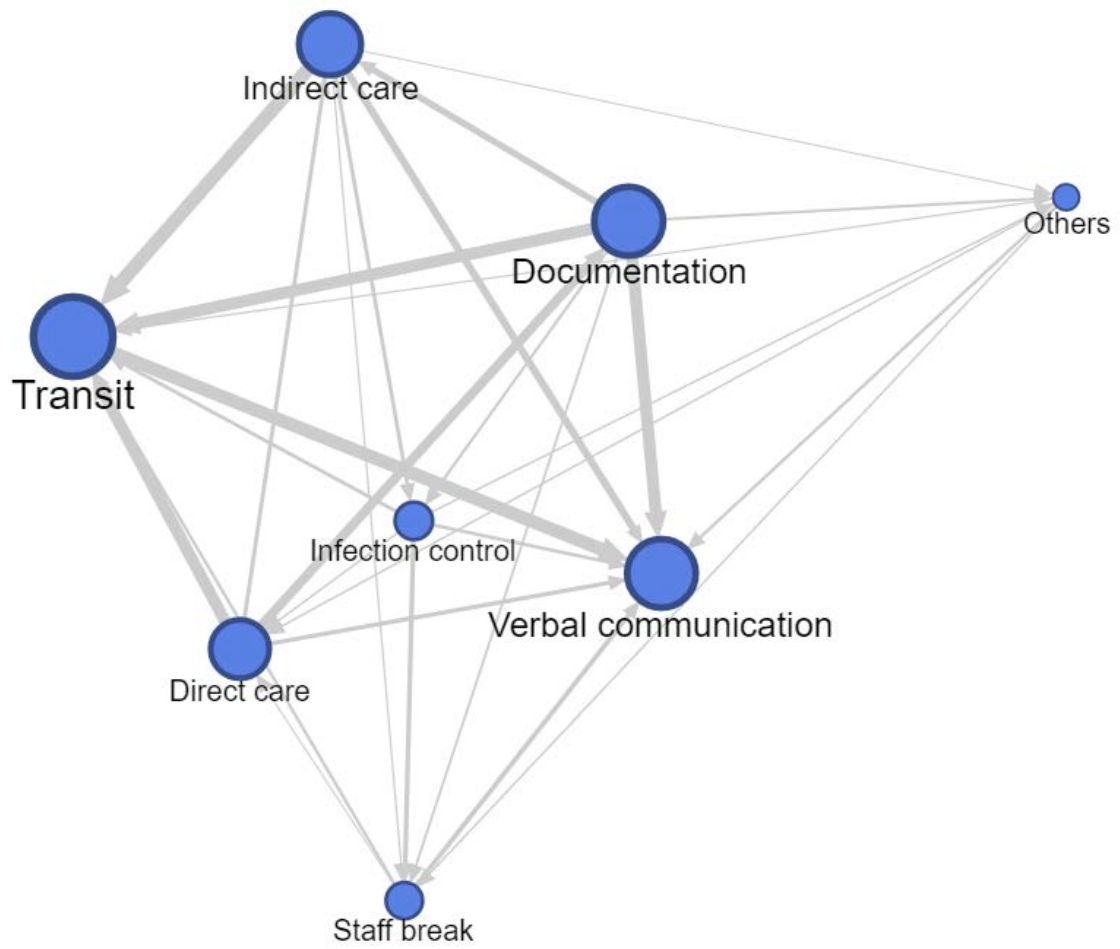


Figure 4. Switches between activities.