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ORIGINAL ARTICLE

Refinement, reliability and validity of the Time Capture Tool (TimeCaT) using the Omaha System to support data capture for time motion studies

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Abstract

Aim: To refine and assess the inter-rater reliability and content validity of the embedded interface of nursing/midwifery activities in the Time Capture Tool (TimeCaT) using an interface terminology, the Omaha System.

Methods: This methodological study was conducted in two Family Health Centers (FHCs) in Turkey with a total of 13 nurses and midwives. In phase one, five nurses/midwives in a FHC were observed for a total of 80 hr, and 84 nursing/midwifery activities were generated and validated with 15 content experts. In phase two, the nursing/midwifery activities were mapped to the Omaha System and inter-rater reliability of the mapping was assessed. The mapping was validated with seven content experts. The nursing/midwifery activities were embedded in the interface of the TimeCaT. In phase three, the embedded interface of the TimeCaT was evaluated while observing eight nurses and midwives in the other FHC.

Results: The scale-level content validity index was 0.98 for the generated activities in phase one and 0.96 for the mapped activities in phase two. Kappa statistics for inter-rater reliability was 0.88 for Omaha System problems, 0.83 for categories and 0.83 for targets. The nursing/midwifery activities were adequately mapped to the Omaha System. The embedded interface of the TimeCaT has acceptable inter-rater reliability and content validity values for using in the Turkish FHC context.

Conclusion: The study results confirm that the TimeCaT using the Omaha System is a valid and reliable tool to measure nursing/midwifery workflow in FHC settings.

KEYWORDS

Omaha System, reliability, standardized nursing terminology, time and motion study, validity

1 | INTRODUCTION

Nurses and midwives constitute the largest group of health service providers around the globe and their services are crucial for attaining national health goals of their countries (The Institute of Medicine, 2010; World Health Organization, 2013). Understanding their workflow is important in today's complex healthcare environments to enhance their contribution to health care and patient outcomes. In recent years, major changes such as information technology systems in the healthcare environment have impacted nursing workflow, quality of care, and patient safety (Cain & Haque, 2008; Cao & Naruse, 2019; Schenk et al., 2018; Whittenburg, 2010). Time and motion (T&M) study is a critical technique

to assess nursing workflow in healthcare settings. (Hendrich, Chow, Skierczynski, & Lu, 2008; Lopetegui et al., 2014; Schenk et al., 2018; Yen et al., 2018).

Time and motion study is defined as "the observation and analysis of movements in a task with emphasis on the amount of time required to perform the task" (U.S. National Library of Medicine, 2018). In the early 20th century, T&M study was used by industrial engineers to obtain detailed knowledge on processes, and improve productivity (Lopetegui et al., 2014; Tapp et al., 2006). In T&M study, an external observer captures data on the time and motion which represents duration of tasks and workflow with an analysis (Lopetegui et al., 2014; Zheng, Guo, & Hanauer, 2011). T&M study was originally intended to promote business efficiency, although it is also a useful method in healthcare organizations to improve workload and productivity of nurses (Burke et al., 2000; Hendrich et al., 2008; Lopetegui et al., 2014; Schenk et al., 2018; Yen et al., 2018; Yoon et al., 2015; Zheng et al., 2011).

In healthcare settings, nurses commonly perform complex and co-occurring interventions in multiple locations (Kalisch & Aebersold, 2010; Schenk et al., 2017; Yen et al., 2016). A wide range of results of nurses' multitasking activities and interruptions in varied clinical settings is reported in T&M literature (Berg et al., 2013; Hendrich et al., 2008; Kalisch & Aebersold, 2010; Schenk et al., 2017; Yen et al., 2018). Various methods have been used in T&M studies for measuring nursing workflow (Berg et al., 2013; Edwards et al., 2009; Schachner et al., 2015; Schenk et al., 2017; Yen et al., 2018). In some of the T&M studies a traditional method with paper and pencil was used to measure nursing workflow (Berg et al., 2013; Edwards et al., 2009; Schachner et al., 2015). In a study by Berg et al. (2013), nurses' and doctors' interruptions and their perceptions of interruptions were determined with handwritten documentation and interview. In another study, researchers used audio recordings to record communication tasks and monitor interruptions (Spencer, Coiera, & Logan, 2004). However, it can be challenging to observe and record rapid and complex nursing work in the clinical settings with the traditional methods. (Burke et al., 2000; Lopetegui et al., 2014; Tapp et al., 2006; Yoon et al., 2015) Additionally, concurrent verbal and non-verbal activities of nurses can be hardly captured with paper-pencil methods (Burke et al., 2000; Yoon et al., 2015; Zhang et al., 2011). In one study it was found that an electronic time capture tool was a practical and reliable way to collect and analyze T&M data to evaluate multitasking of nurses (Yen et al., 2016). Thus, electronic T&M study tools can be more efficient and accurate than paper-pencil methods (Burke et al., 2000; Lopetegui et al., 2014; Schenk et al., 2017; Tapp et al., 2006; Yoon et al., 2015).

Standardizations of T&M study instruments are required for collecting nursing workflow data coherently and comparing the data between T&M studies. (Lopetegui et al., 2014; Schenk et al., 2017; Zhang et al., 2011). In several T&M studies, it was noted that linking an existing interface terminology to the data collection tool was feasible to describe nursing activities in a standardized manner (Fratzke, Melton-Meaux, & Monsen, 2013; Schenk et al., 2017; Zhang et al., 2011). Also, the use of the standardized data collection tool in T&M studies makes it easier and practical in comparing the data across studies (Fratzke et al., 2013; Lopetegui, Yen, Lai, Embi, & Payne, 2012; Schenk et al., 2017; Zhang et al., 2011). Furthermore, measurement of workflow with a standardized nursing terminology embedded in an electronic tool could gain adequate insight into nurses' workflows as they provide care in today's complex healthcare environment (Fratzke et al., 2013; Schenk et al., 2017).

1.1 | Interface terminologies

Interface terminologies are a set of clinical terms in computer programs that enable meaningful documentation, complete problem lists, efficient and accurate data collection (Kanter, Wang, Masarie, Naeymi-Rad, & Safran, 2008). Nurses interact with interface terminology when documenting care in electronic health records (Baisch, 2012; The Office of the National Coordinator for Health Information Technology, 2017; Westra, Delaney, Konicek, & Keenan, 2008). The American Nurses Association (2012) recognized 12 standardized terminologies to support nursing practice. Of these, the Omaha System allows critical thinking processes, determination of problems and interventions, and evaluation of outcomes (Martin, 2005). In addition, its comprehensive and simple structure makes it a powerful interface terminology (Fratzke et al., 2013; Martin, 2005;Schenk et al., 2017 ; Zhang et al., 2011).

The Omaha System has been proven to be applicable for documenting primary care services and nursing activities in other settings (Baisch, 2012; Erdogan et al., 2013; Johnson, McMorris, Raynor, & Monsen, 2013; Monsen et al., 2010; Monsen & Newsom, 2011; Westra, Oancea, Savik, & Marek, 2010). Numerous studies have demonstrated the applicability of the Omaha System for nursing activities documentation in electronic health records (Gao, Kerr, & Monsen, 2016; Monsen & Newsom, 2011; Southard, Bark, Erickson, & Monsen, 2017; Westra et al., 2010). The structure of the Omaha System is also used to organize nursing activities in electronic T&M study tools (Fratzke et al., 2013; Schenk et al., 2017; Zhang et al., 2011). In acute-care settings, the Omaha System was used as an interface terminology in T&M instruments to measure nurses' work (Schenk et al., 2017; Zhang et al., 2011); however, there is a

lack of standardization for systematically evaluating nursing and midwifery workflow in Family Health Centers (FHCs). To the best of our knowledge, there is no observational tool that uses the Omaha System as an interface terminology for evaluating nursing and midwifery workflow in FHC in Turkey. Thus, the aim of this study was to refine and assess the inter-rater reliability and content validity of the embedded interface of nursing/midwifery activities in the Time Capture Tool (TimeCaT) to capture nursing and midwifery workflow in a FHC using an existing interface terminology, the Omaha System.

2 | METHODS

2.1 | Design and sample

A methodological study design was used to examine the refinement, reliability and validity of the embedded interface of nursing/midwifery activities in the TimeCaT for capturing nursing and midwifery workflow in FHCs using a standardized interface terminology, the Omaha System. The study was undertaken between September 2015 and May 2016 at two FHCs in Istanbul, Turkey. In the study, convenience samples of seven nurses and six midwives were included. Inclusion criteria were: (a) to have a bachelor's degree; (b) to have worked at the FHC for at least 1 year; (c) to prove a signed informed consent to participate in the study.

The sample was recruited from two FHCs. In one FHC, there were three nurses and two midwives where the researcher observed nursing/midwifery activities. In the other FHC, there were four nurses and four midwives where the embedded interface of the TimeCaT was evaluated. In FHC, nurses and midwives work 8 hr in a day and 40 hr in a week. In Turkey, in FHCs, primary care services are delivered by nurses and midwives who are responsible for the same scope of practice such as illness prevention, immunization, monitoring infant/child growth, assessing pregnant and postpartum women, health screening, health education and so on (Republic of Turkey Ministry of Health, 2014). Ethics approval was obtained from the ethics committee of the Institutional Review Board Committee of the Istanbul Medipol University (IRB Approval No. 566), and institutional permissions were obtained from the directors of Turkish Public Health Institution and participating FHCs.

2.2 | Instruments

The TimeCaT, developed by Lopetegui et al. in 2012 at the Department of Biomedical Informatics in Ohio State University, is an open source T&M study tool to observe and record predefined activities with Tablets and Pads. It is a customizable, user-centered web application developed to support data collection for T&M studies (Lopetegui et al., 2012; Schenk et al., 2017; Yen et al., 2016).

The TimeCaT provides accurate data with the touch-timestamp feature, capturing multitasking with a novel three-dimensional approach, a qualitative and a quantitative approach with inter-observer reliability, accessing real-time reports of observations with a cloud-based system, and scheduling of observations (Lopetegui et al., 2012). The TimeCaT can describe nursing workflow in three activity dimensions: task, communication, and location (Figure 1) (Yen et al., 2016). *Task* is a group of activities that cannot happen at the same time, while tasks from different groups such as communication can be executed simultaneously (Lopetegui et al., 2012). Task dimension involves nurses' main activities such as blood sample collection, Pap smear test, immunization, documentation, monitoring (blood pressure, edema, weight etc. in pregnancy), medication administration. *Communication* addresses nurses' activities based on speech such as the exchange of information, opinion, and feelings among people (health education, counseling etc.). *Location* includes places where activities occur. It is hard to simultaneously record the performance of two or more tasks without these separate dimensions in T&M tools because health professionals often deal with different types of activities such as talking with a client, documentation, monitoring, intravenous intervention, and sometimes need to do their activities in different locations such as medical intervention room, hallway, patient room, nursing room (Lopetegui et al., 2012; Schenk et al., 2017; Yen et al., 2016). The TimeCaT allows observers to select and record activities from a list of activities in these three dimensions without prioritization during observation (Lopetegui et al., 2012; Yen et al., 2016), thus enabling measurement of both single tasks and multitasking for investigators. This tool is available at https://lopetegui.net/timecat/39/login/.

In the study, the TimeCaT was modified for systematically evaluating T&M study methods of nursing and midwifery in the FHC using a standardized interface terminology, the Omaha System. The Omaha System has three components: Problem Classification Scheme, Intervention Scheme and Problem Rating Scale for Outcomes. Problem Classification Scheme comprises 42 problems in four domains (environmental, psychosocial, physiological, and health-related behaviors). Intervention Scheme is a care plan that aims to promote health, prevent or decrease sign/symptoms of diseases. The scheme includes four categories, 75 targets, and client-specific information. Four intervention categories are Teaching, Guidance, and Counseling, Treatments and Procedures, Case Management, Surveillance. The problem rating scale for outcomes is an ordinal measure of three problem-specific dimensions: knowledge, behavior,

FIGURE 1 Screenshot of refined TimeCaT in the Turkish context

and status. The Omaha System terms can be used within software (Martin, 2005).

In the study, sociodemographic and other basic information such as age, education, marital status, and years of working experience were collected via a survey.

2.3 | Procedures

A three-phase approach was used for refinement of the embedded interface of the TimeCaT in the study (Figure 2). Phase one included observations of nurses and midwives for creating activity lists in the FHC. Phase two involved mapping of the nursing/midwifery activities to the Omaha System terms (problem+category+target+care description). And phase three involved evaluation of the interface of the TimeCaT.

2.3.1 | Phase 1: Observation of nurses and midwives

In the study, three nurses and two midwives were observed at the point of care in 10 days for a total of 80 hr in the FHC by the first author (MA). The observer was the nursing PhD student who has a clinical background and experience, familiar with nursing workflow in FHCs and was able to recognize and distinguish various nursing and midwifery activities. The data from these sessions provided primary observations of nursing and midwifery activities in the FHC. These notes were then summarized, listed by the authors (MA, SS). Demographic and other basic information about the nurses and midwives including age, marital status, education, years of experience in FHC were collected.

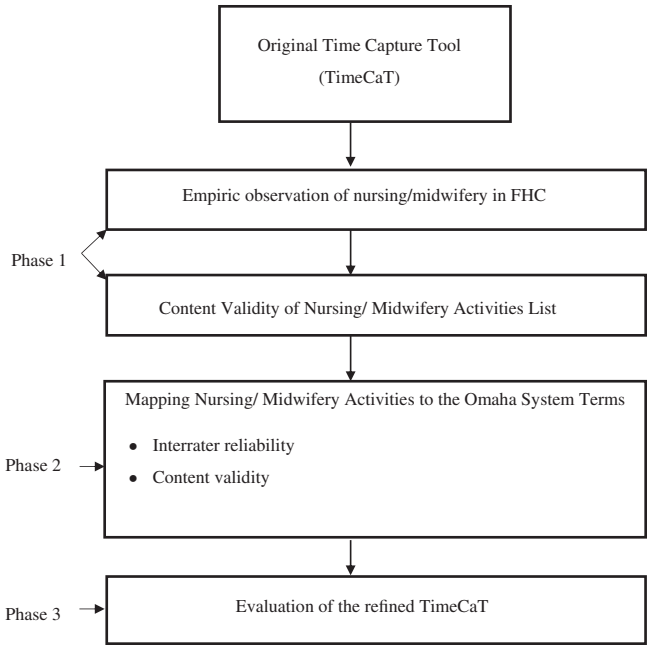

FIGURE 2 Overview of study design

The nursing/midwifery activities list was then assessed by 15 content experts to finalize nursing and midwifery activities. Content experts included one public health nursing academic from a faculty of nursing and 14 practicing nurses and midwives working in FHC. A four-point ordinal Likert rating scale was used to evaluate the content validity of each nursing/midwifery activity. A value of one (test not being relevant) to four (highly relevant) was used for rating the relevance of each nursing/midwifery activity by experts. In the scale, at the bottom of each item, space was allowed to add any qualifying or qualitative comments for content experts. In the first round, analysis of relevance scores and qualitative commentary were made using descriptive statistics and the measure was edited. Grade 3 (quite relevant) and 4 (highly relevant) were considered as acceptable (Lynn, 1986). Then, the observable nursing/midwifery activities list was finalized and there were 84 activities in the list.

2.3.2 | Phase 2: Mapping observations to the Omaha System

In the second phase of the refinement study, the TimeCaT was customized by the authors (MA, SS) for capturing nurse/midwife interventions in the FHC using the Omaha System. Each of the defined nursing activities was mapped to the Omaha System terms of problem, category, target and care description by the first author (MA) and inter-rater reliability was assessed by another nursing terminology expert with extensive experience with the Omaha System (SS). This mapping was discussed with seven content experts who were experienced with the Omaha System. Content experts included six public health nursing academics from faculties of nursing in Turkey and one academic in public health

TABLE 1 Examples of selected nursing/midwifery activities with Omaha System activities combinations in TimeCaT

Dimension	Name (interface)	Care description	Problem-category-target
Communication	>pregnancy information	Collecting information about pregnancy	Health care supervision–S–continuity of care
Communication	%caretaking	Providing information to parent about caretaking and parenting skills	Caretaking/parenting–TGC–caretaking/parenting skills
Communication	>risk in postpartum	Risk assessment in the postpartum period	Postpartum–S–screening procedures
Communication	%nutrition in pregnancy	Providing information to pregnant woman about nutrition	Pregnancy–TGC–dietary management
Communication	::screening for infants	Referring infants to other healthcare institution for screenings and tests	Growth and development–CM–screening procedures
Task	::FMIS	Recording to family medicine information system	Healthcare supervision–CM–continuity of care
Task	>children height/weight	Checking height-weight of children	Growth and development–S–sign/symptoms-physical
Task	*blood specimen	Collecting blood specimen and sending to laboratory	Healthcare supervision–TP—specimen collection
Task	>vital sign in pregnancy	Checking vital signs in pregnancy	Pregnancy–S–sign/symptoms-physical
Task	*immunization for infant/child	Immunization for infant/child	Growth and development–TP–wellness
Location	hallway	In hallway as a destination	
Location	examination room	In nurses' interventions room	

Abbreviations: CM, Case management; S, Surveillance; TGC, Teaching, guidance, and counseling; TP, Treatments and procedures.

TABLE 2 Content validity index (CVI) of the mapped nursing/midwifery activities list to the Omaha System terms

Items	CVI	Items	CVI	Items	CVI
1	0.85	29	1.00	57	1.00
2	0.85	30	1.00	58	1.00
3	0.85	31	0.85	59	1.00
4	0.85	32	1.00	60	1.00
5	0.85	33	1.00	61	1.00
6	1.00	34	0.85	62	1.00
7	1.00	35	1.00	63	1.00
8	1.00	36	1.00	64	1.00
9	1.00	37	1.00	65	1.00
10	1.00	38	1.00	66	1.00
11	1.00	39	1.00	67	1.00
12	1.00	40	0.85	68	1.00
13	1.00	41	0.85	69	1.00
14	1.00	42	0.85	70	1.00
15	1.00	43	1.00	71	1.00
16	1.00	44	1.00	72	1.00
17	1.00	45	0.85	73	1.00
18	1.00	46	0.85	74	1.00
19	0.85	47	0.85	75	0.85
20	1.00	48	1.00	76	0.85
21	1.00	49	1.00	77	1.00
22	1.00	50	1.00	78	1.00
23	1.00	51	1.00	79	1.00
24	1.00	52	0.85	80	1.00
25	1.00	53	1.00	81	1.00
26	1.00	54	1.00	82	1.00
27	1.00	55	1.00	83	1.00
28	1.00	56	1.00	84	1.00

Scale-level CVI = 0.96.

nursing and nursing informatics in the USA. Then, interfaces of mapping were created and the nursing/midwifery activities were embedded in the TimeCaT. The TimeCaT interface included 84 nursing/midwifery activities that were mapped to the Omaha System: an interface terminology designed to describe health care activities by interventions consisting in combined terms (problem + category + target + care description). To visualize terminology in TimeCaT interfaces, the Omaha System categories were identified with special symbols as Teaching, Guidance, and Counseling (TGC; shorthand icon = %); Treatments and Procedures (TP; shorthand icon = *); Case Management (CM; shorthand icon = ::); and Surveillance (S; shorthand icon = >) (Schenk et al., 2017). For example, "% pregnancy hygiene" was an interface that explained a task of nursing/midwifery, defined as a "nurse gives education, guidance and counseling to a pregnant woman about personal hygiene". Finally, this content was entered into task and communication dimensions of the TimeCaT to enable data collection by observers (Figure 1). See representative examples of selected nursing/midwifery activities in Table 1.

2.3.3 | Phase 3: Evaluation of the refined TimeCaT

The final interface of nursing/midwifery activities of the TimeCaT was evaluated by a total of 19 hr observations of four nurses and four midwives in the other FHC using an iPad. No changes were made in refining processes of the tool.

2.4 | Data collection

Before the direct observations, the first author (MA) explained the study to nurses and midwives and obtained informed consent from them. When the nurses/midwives provided care to the clients during the observation, the author asked permission to observe from both the nurses/midwives and the clients. The author explained to the clients that the nurses/midwives were the subject of the study, and stated that observation would not affect their services in the FHC. When the clients refused to be observed or the nurses/midwives declined to be observed due to the nature of the client, the author stopped observing the nurses/midwives until they completed the services. When oral consent was obtained from the clients, the nurses/midwives introduced the author to the clients. The author did not interact with the clients during the observation. The observations were made at varied days of the month, depending on the availability of the nurses/midwives. Each observation lasted for 8 hr between 8 a.m. to 4 p.m. No health records were collected during the data collection period and the data were securely stored in the iPad.

2.5 | Data analysis

The data were analyzed using IBM SPSS Statistics for Windows, version 16.0 (IBM, Armonk, NY, USA). The authors used multiple Microsoft Excel spreadsheets to map the nursing/midwifery activities to the Omaha System. Kappa statistic was used to test the agreement on mapping. Kappa values less than 0 indicated no agreement, 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement (McHugh, 2012). Content validity indexes (CVIs) were calculated to validate the nursing/midwifery activities list and

TABLE 3 Summarized mapping of nursing/midwifery activities to the Omaha System terms

Problem	Category				Number of different targets
	CM	S	TGC	TP	
Healthcare supervision	11	10	4	3	9
Pregnancy	1	6	8	2	9
Postpartum	0	4	7	1	9
Growth and development	1	6	0	2	5
Family planning	0	2	0	2	1
Medication regimen	0	0	2	1	2
Circulation	0	1	0	1	1
Reproductive function	0	0	1	1	2
Communicable/infectious condition	0	0	0	1	1
Caretaking/parenting	0	0	1	0	1
Skin	0	0	0	1	1
Personal care	0	0	2	0	1
Substance use	0	0	1	0	1
Neighborhood/workplace safety	0	0	0	1	1

Abbreviations: CM, Case management; S, Surveillance; TGC, Teaching, guidance, and counseling; TP, Treatments and procedures.

the mapping with the Omaha System terms. Descriptive statistics were used to evaluate the mapped Omaha System Problem, Category, and Target from nursing/midwifery activities.

3 | RESULTS

3.1 | Refinement, reliability and validity

After 10 observational sessions for a total of 80 hr in the first FHC, 84 nursing/midwifery activities were listed by the authors (MA and SS) and then the list was rated by 15 content experts to evaluate CVIs. The item-level CVIs varied between 0.80 and –1.00 for each activity and the scale-level CVI was 0.98 for the nursing/midwifery activities list.

Each activity in the refined nursing/midwifery activities list was mapped to the Omaha System terms. The overall inter-rater percent agreement were 97.9, 95.7 and 95.7%, and Kappa statistics were .88, .83, and .83 for problem, category, and target, respectively. The CVIs of the mapped nursing/midwifery activities list were also assessed with seven content experts. The item-level CVIs varied 0.80–1.00 for each activity and the scale-level CVI of the list was 0.96, thereby demonstrating acceptable content validity (Table 2). The location (examination room, hallway, laboratory, medical intervention room, and home) and personal activities (eating/drinking, personal break) were not mapped to the Omaha System terms.

In the study, 84 activities were mapped to 14 problems, four categories and 24 targets of the Omaha System (Tables 3 and 4). The most common problem was Health care supervision followed by Pregnancy, Postpartum and Growth and development (Table 3). In the Omaha System Intervention Scheme, all categories were mapped to 84 nursing/midwifery activities and the most common targets were Signs/symptoms-physical, Screening procedures, Continuity of care, Family planning care, Communication, Anatomy/physiology, Dietary management, Wellness, Caretaking/parenting skills, Dressing change/wound care (Table 4).

3.2 | Refined TimeCaT evaluation

There were 84 nursing/midwifery activities, 37 communication activities and 47 hands-on tasks, identified and embedded in the TimeCaT (Figure 1). During 19 hr of observations, 123 events, were recorded in the TimeCaT. Unobserved or unrecorded were 21 nursing/midwifery activities (25%), including *urine specimen, *ECG, *vitamin D (pregnancy), *vitamin D (postpartum), *breast self-examination, *intrauterine device, *medical waste disposal, >risk in pregnancy, >fecal occult blood, >fundal height, >visual screening (children), >vital (adult), >checking intrauterine device, >healing of incision in postpartum, %postpartum exercise, %pregnancy exercise, %breastfeeding (pregnancy), %family planning (pregnancy), ::supply-chain management, ::cold chain, and ::home care for elderly.

4 | DISCUSSION

Better understanding on nursing workflow can promote patient-centered, effective, and efficient care (Cain & Haque,

TABLE 4 Distribution of mapped Omaha System targets from nursing/midwifery activities

Targets	Frequency
Signs/symptoms-physical	13
Screening procedures	12
Continuity of care	9
Family planning care	6
Communication	6
Anatomy/physiology	5
Dietary management	5
Wellness	4
Caretaking/parenting skills	3
Dressing change/wound care	3
Exercises	2
Medication action/side effects	2
Personal hygiene	2
Specimen collection	2
Supplies	1
Signs/symptoms-mental/emotional	1
Feeding procedures	1
Growth/development care	1
Environment	1
Infection precautions	1
Safety	1
Medication administration	1
Substance use cessation	1
Medical/dental care	1

2008; Cao & Naruse, 2019; Whittenburg, 2010). The reliable and valid T&M study methods will help to develop effective strategies that can minimize errors and enhance patient safety (Lopetegui et al., 2014; Yen et al., 2016). However, inconsistent approaches were used to measure nurses' workflow (Hendrich et al., 2008; Lopetegui et al., 2012; Schachner et al., 2015; Schenk et al., 2017; Yen et al., 2016; Zhang et al., 2011). To capture nursing and midwifery workflow in FHC and evaluate the proposed T&M study approach, a standardized interface terminology, the Omaha System was embedded in the TimeCaT and the inter-rater reliability and content validity of interface of the tool were assessed. This is the first study to assess the inter-rater reliability and content validity of the embedded interface of nursing/midwifery activities in the TimeCaT to measure nursing and midwifery workflow using the Omaha System in the Turkish context.

The content validity of the tool was evaluated by the content experts and assessed through the observations. According to the scale-level CVI of higher than 0.80, the tool was considered to have high content validity. Furthermore, the inter-rater reliability was measured and high Kappa statistics indicated good agreement among the reviewers. Thus, the TimeCaT using the Omaha System is a valid and reliable tool to measure nursing and midwifery workflow in FHC settings.

The study results were consistent with previous studies in which the Omaha System was successfully mapped to nursing activities in other settings (Fratzke et al., 2013; Monsen, Schenk, Schleyer, & Schiavenato, 2015; Schenk et al., 2017; Zhang et al., 2011). Use of the Omaha System has a critical importance for evaluating nursing workflow data in T&M studies because its structure describes nursing activities simply, comprehensively and holistically (Fratzke et al., 2013; Schenk et al., 2017; Zhang et al., 2011). Thus, nursing workflow data from the TimeCaT can be more reliable, comprehensible and interpretable with the Omaha System that has standardized data. There is also a potential to further evaluate and compare the nursing workflow data between T&M studies using this tool.

Nursing activities can be changed in the various healthcare settings. For example, in a medical-surgical inpatient unit, nursing activities were described with Omaha System terms of communication, education, signs/symptoms-physical and medication administration that were added to a T&M instrument (Zhang et al., 2011). In another study in an acute-care setting, most of the nursing activities were reported with Omaha System terms of communication, signs/symptoms-physical and medication administration (Fratzke et al., 2013). In the present study, nursing and midwifery activities in FHC focused on the Omaha System terms of signs/symptoms-physical, screening procedures, continuity of care and family planning care that were added into the TimeCaT. Thus, in future T&M studies, the TimeCaT can be customized according to the focus of the settings.

4.1 | Limitations of the study

Observations of nurses/midwives in one FHC may limit generalizability of our study. The observations at phase three occurred over a 1-month period which may introduce bias due to seasonal variations in FHC admissions. Nurses/midwives volunteered to participate in the study and this may result in a recruiting-biased sample. The TimeCaT requires stable internet access, which can be interrupted with technical problems.

5 | CONCLUSION

To our knowledge, this is the first study of the psychometric refinement of the TimeCaT with a standardized interface

terminology to measure nursing and midwifery workflow in FHCs in Turkey. Results of the study showed acceptable inter-rater reliability and content validity of the embedded interface of nursing/midwifery activities in the TimeCaT. The mapping of Omaha System terms to nursing and midwives' activities was successful in the study. The TimeCaT can be used in nursing/midwifery T&M studies at FHCs and may be customized for use in various healthcare settings.

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DISCLOSURE

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

MA and SS contributed to the conception and design of this study; MA carried out the data collection; MA and SS conducted the data analysis, drafted the manuscript, and revised it critically for important intellectual content. YJK critically reviewed the manuscript. All authors read and approved the final manuscript.

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