Supplementary file 1. Study characteristics, according to the study design

Authors, years, country, setting, and study period	Aims and study design	Sampling method, target population, participants, and demographics	Instrument/tools used to measure explanatory variables and UNC endpoint
Cross-sectional studies			
Al-Kandari et al., 2009 [54] Kuwait General medical and surgical wards of the regional hospitals (n = 5) of the Ministry of Health Period: N/A	To assess the workload of nurses; the nursing activities (tasks) nurses commonly performed on medical and surgical wards; elements of nursing care activities left incomplete by nurses during a shift; factors contributing to task incompletion; and the relationship between staffing, demographic variables, and task incompletion Exploratory study	Convenience Nurses: 820 Participants: 780 (95%) Females: 73% Median age: 29.9 yrs Nursing certificate: 4.5% BSN: 33.8% Associate degree or equivalent in nursing: 61.6% Mean experience as nurse: 5.14 yrs	Staff characteristics: age, gender, nationality, area of work, education, years of experience Unit profile: bed capacity of the unit, nurse-to-patient ratio, number of unstable patients assigned, emergencies encountered during the shift, frequency of various nursing and non-nursing tasks performed during the shift Nursing activities: tasks left undone modified in the items Modified tasks left undone instrument
Ausserhofer et al., 2014 [46] Belgium, England, Finland, Germany, Greece, Ireland, the Netherlands, Norway, Poland, Spain, Sweden, Switzerland European hospitals (n = 488) Period: 2009–2010	1. To describe the prevalence and patterns of nursing care left undone in a large sample of hospitals across 12 European countries 2. To explore the association between the organisational context of nursing – including the nurse work environment, nurse staffing, and requirements that nurses carry out non-nursing tasks – and nursing care left undone Multi-country, multi-level cross-sectional study	Convenience Professional nurses: 33,659 Participation: 62% Females: 93% BSN: 54% Average experience: 10.3 yrs	Quality of the nurse work environment: staffing and resource adequacy, nurse manager ability, leadership, support of nurses, collegial nurse–physician relations, nurse participation in hospital affairs, nursing foundations for quality of care Nurse staffing level Non-nursing tasks Staff characteristics: gender, nursing education, employment level, professional experience in the hospital where they were currently working Potential confounding variables: teaching status, high technology, that is, hospitals providing open heart surgery or organ transplantation, hospital size RN4CAST nurse questionnaire
Ball et al., 2014 [39] England General medical/surgical wards (n = 401) in 31 acute National Health Service hospitals Period: 2010	To describe the nature and prevalence of care left undone (as reported by nurses) and explore its association with nurse staffing levels and nurse ratings of the quality of care and patient safety environment Cross-sectional study	Random stratified Nurses: 2,917 Participation: 39% Females: 92% Mean age: 39.6 yrs (SD 10.1 yrs) BSN: 27% Length of service as a nurse: 13.8 yrs (SD 10.6 yrs)	Nurse staffing: patients per RN providing direct care, patients per non-RN staff, proportion of the nursing team providing direct care that were RNs Nurse work environment: managerial support for nursing, nurse participation in hospital affairs, doctor–nurse relations, promotion of care quality Quality of care Patient safety Care left undone: 'On your most recent shift, which of the following activities were necessary but left undone because you lacked the time to complete them?'; 13 nursing care activities were presented Practice Environment Scale of the Nursing Work Index One item from the Agency for Healthcare Research and Quality's hospital survey Care left undone
Ball et al., 2016 [85] Sweden General medical or surgical wards (n = 79) of acute hospitals in Sweden Period: 2010	1. To examine factors associated with RN reports of care left undone on acute medical/surgical wards 2. To describe the relationship between staffing levels and care left undone Cross-sectional study (part of the RN4Cast study)	Sampling method: N/A RNs: 33,083 Participation: 70% Females: 93.1% Mean age: 39.7 yrs BSN: 58.8%	Demographics: age, gender, education, working hours, last shift worked, role, length of service Nurse staffing: patients/RN, patients/nursing support worker, total nurse staffing Patient dependency and acuity Practice environment: nurse participation in hospital affairs, managerial support, promotion of care quality, relationships between nurses and doctors Role in care provision Transferrable activity Elements of MNC Practice Environment Scale of the Nursing Work Index Basel Extent of Rationing of Nursing Care instrument
Ball et al., 2018 [47] Belgium, England, Finland, Ireland, Netherlands, Norway, Spain, Sweden, Switzerland Hospitals (n = 300) Period: 2009–2010	To examine if MNC mediates the observed association between nurse staffing levels and mortality Observational study	Convenience RNs: 26,516 Participation: 62% N/A	Mortality following surgery within 30 days of admission: administrative data on discharge status, length of stay and adjusted for surgical procedure undergone, patient age, sex, and admission type Elements of MNC Demographics: number of staff providing direct patient care, number of patients on their ward on the last shift that they worked, nurse practice environment, nurse education levels Control variables: hospital bed size, teaching status, technology Practice Environment Scale MNC: 'On your most recent shift, which of the following activities were necessary but left undone because you lacked the time to complete them?'; composed of 13 activities

Bekker et al., 2015 [58] South Africa Medical and surgical units (n = 60) in six public and private hospitals in six provinces of South Africa Period: N/A	To investigate the relationship between non-nursing tasks, nursing tasks left undone, and job satisfaction among professional nurses in medical and surgical units in private and public hospitals in South Africa Cross-sectional study	Convenience Professional nurses: 2,122 (final sample of 1,166) Participation: 38.2% for private hospitals and 53.3% for public hospitals Females: 95.6% BSN: 14.3%	Job satisfaction: specific aspects of nurses' job, the level of job satisfaction, namely work schedule flexibility, opportunities for advancement, independence at work, professional status, wages, educational opportunities Non-nursing tasks: delivering and retrieving food trays, performing non-nursing care, arranging discharge referrals and transportation, routine phlebotomy/blood drawing for tests, transporting of patients within hospital, cleaning patients' rooms and equipment, filling in for non-nursing services not available on off-hours, answering phones, clerical duties Nursing tasks left undone: adequate patient surveillance, skin care, oral hygiene, pain management, comfort/talk with patients, educating patients and family, treatments and procedures, administer medications on time, prepare patients and families for discharge, adequately document nursing care, develop or update nursing care plans/care pathways, planning care, frequent changing of patient position Demographics RN4CAST paper-based survey, section C for nursing care left undone
Blackman et al., 2014 [37] Australia Australian Nursing and Midwifery Federation-South and Australian Branch Association Period: 2012	1. To explore which factors influenced the nursing care reported as being missed by nursing staff 2. To estimate and explain how much variance among different factors can be used to predict why nursing care is likely to be missed Non-experimental exploratory study	Convenience Nurses: 289 Participation: 100% Females: 90% < 25 yrs: 2%; 25–34 yrs: 12%; 35–44 yrs: 20%; 45–54 yrs: 37%; 55–64 yrs: 27%; > 65 yrs: 2% < 2 yrs of experience: 13%; 2–5 yrs: 14%; 5–10 yrs: 16%; > 10 yrs: 57%	Reason for MNC MISSCARE Survey (only Part B)
Blackman et al., 2017 [48] Australia, Cyprus, Italy Australia: Australian Nursing and Midwifery Federation Association Cyprus: medical and surgical units of six acute care hospitals Italy: 12 hospitals Period: N/A	1. To identify whether the frequencies and types of MNC differ significantly between countries 2. To understand if the incidence of MNC can be modelled and predicted Non-experimental, exploratory, quantitative study	Australia: randomised Cyprus and Italy: convenience Australia: 7,097 nurses and midwives Cyprus: 959 nurses Italy: 467 nurses Sample: 1,896 Participation: Cyprus: 81% Italy: 77.9% Female: 82% < 25 yrs: 5%; 25–34 yrs: 47%; 35–44 yrs: 21%; 45–54 yrs: 12%; 55–64 yrs: 13%; > 65 yrs: 2% < 1 yr of experience: 11%; 1–5 yrs: 40%; 5–10 yrs: 30%; >15 yrs: 19% Non-university: 19% BSN: 63% Above BSN: 18%	Demographics characteristics Working conditions Elements of MNC: high priority care (e.g., vital signs assessed as ordered, hand washing), intermediate priority care (e.g., ambulation three times day, as ordered, turning patient every 2 hours), low priority care (e.g., monitoring intake/output, full documentation all necessary data) MISSCARE survey (Part A and B)
Blackman et al., 2018 [60] Australia Australian Nursing and Midwifery Federation Association Period: 2012–2015	1. To determine what factors would account for maximum variation in the total MNC score 2. To determine why care omissions occur Non-experimental, descriptive study	Convenience Nurses and midwifes: N/A Participation: 1,195 Certificate/enrolled nurse: 15% RN diploma: 23% BSN: 40% Graduate diploma: 13% MSN or higher: 9%	Demographic characteristics Care setting type Working conditions Elements of MNC Reasons for MNC MISSCARE survey (Part A and B)
Blackman et al., 2019 [11] Australia Residential aged care (number N/A) Period: N/A	1. To identify the types and frequencies of MNC 2. To identify the demographic factors that serve as antecedents or have predictive qualities regarding missed residential aged care Multivariate approach study	Convenience Staff components: 3,079 Participation: 2,467 (80.1%) Care workers: 36% Enrolled nurses: 26% RNs: 36% Nurse practitioners: 2%	Demographics: age, years of experience, qualifications, staffing model used in the facility Missed residential aged care: care done to minimising residents' distress, nursing care to maximise the residents' current health status, care to strengthen the residents' life potential Elements of MNC Australian Aged Care Funding Instrument MISSCARE survey (Part A and B)

Bragadòttir et al., 2016 [64] Iceland Medical, surgical, mixed medical and surgical, and intensive care inpatient units (n = 27) in one university hospital, three teaching hospitals, and six small regional hospitals Period: 2012	To identify the correlates of hospital, unit, and staff characteristics, and nursing teamwork to MNC in one nationalised health care system Cross-sectional study	Purposive Staff: 864 Participants: 69.3% Females: 98.9% RNs: 62.6% Practical nurse: 37.4% < 34 yrs: 28%; 35–44 yrs: 25.1%; 45–54 yrs: 29.1%; > 55 yrs: 17.8% < 2 yrs of experience: 13.3%; 2–5 yrs: 15%; 5–10 yrs: 18.9%; > 10 yrs: 52.8%	Unit characteristics Staff characteristics: gender, age, job title, number of hours worked per week, work hours, experience in role, experience on current unit, overtime, sick days, staffing adequacy, number of patients taken care of on the last shift Elements of MNC Teamwork trust, team orientation, backup, shared mental model, team leadership MISSCARE Survey-Icelandic (only Part A) Nursing Teamwork Survey-Icelandic
Castner et al., 2014 [56] United States Direct patient care or unit-level management in one specialty children's hospital, two suburban community hospitals, and two urban tertiary care hospitals Period: 2011–2012	To build and to test a multi-level model on the contextual relationships and interactions of individual RN and nursing unit factors on MNC Descriptive, cross-sectional study	Convenience Nurses: 2,509 (the final sample is 553) Participation: 24.2% Females: 94.3% Staff nurse: 96.5% Administrative: 3.5% Diploma: 13.0% Associate degree: 36.9% BSN: 46.7% MSN or higher: 3.4%	Elements of MNC Reasons for MNC Errors of commission: misinterpreting orders, medication error, violating infection precautions, skill error, delegation/supervision error, wrong chart, assignment error Demographics Unit-level variables: case mix index, merger status, medication administration errors and near-misses (bar-coding administration system), incident reports MISSCARE Survey (Part A and B) Survey subscale adapted from the Practice and Professional Issues Survey ADL Omissions
Chapman et al., 2016 [61] Australia Medical, surgical, ICU, specialist wards including coronary care, emergency department, and rehabilitation units in four hospitals Period: 2014	1. To examine teamwork and MNC in one Australian health network 2. To provide evidence of the ameliorating effect of set nurse-to-patient ratios on teamwork and MNC Descriptive study	Convenience and consecutive Nurses: 334 Participation: 89.9% Females: 89.8% RNs: 91% Enrolled nurses: 9% Mean age: 26–34 yrs BSN: 40%–70% > 10 yrs in the same role: 30%–70%	Demographics: hospital, gender, year born, highest education level, country where nursing education occurred, length of time nursing, length of time in current ward/unit/department, description of workplace, work hours, job title, overtime in the last three months, number of missed work days in the last three months, plan to leave current position Elements of MNC Reasons for MNC Teamwork: trust, team orientation, backup, shared mental model and team leadership MISSCARE Survey (Part A and B) Nursing Teamwork Survey
Cho et al., 2015 [81] Korea Highly staffed units (n = 4) and low staffed units (n = 9) of one public hospital Period: 2013	To compare MNC between nursing units with high versus low nurse staffing to examine the effects of nurse staffing on MNC Cross-sectional study	Convenience Nurses: 115 in high staffing units, 117 in low-staffing units Participation: in high staffing units, 94.3%; in low staffing units, 88.6% *High-staffing units versus low-staffing units* Females: 100% versus 95.7% Baccalaureate or higher degree: 38.3% versus 32.8% < 1 year of RN experience: 27.8% versus 17.1%	Elements of MNC Reasons for MNC MISSCARE survey (Part A and B)
Cho et al., 2016 [40] South Korea Acute hospitals (n = 60) Period: 2008–2009	To explore the association of nurse staffing and overtime with patient safety, quality of care, and care left undone Cross-sectional study	Stratified randomisation Staff: N/A Participation: 96.2% Females: 95% Mean age: 28 yrs (SD 4.8 yrs) Diploma: 51.5% Baccalaureate or higher: 48.5% Mean experience: 5.5 yrs (SD 4.6 yrs)	Demographics: age, gender, highest education, years worked as a nurse, job status, job security, working unit, and last shift worked, hospital characteristics Patient safety Quality of care Care left undone Nurse staffing level Nurse's overtime Basel Extent of Rationing of Nursing Care Care left undone Agency for Healthcare Research and Quality's Hospital Survey on Patient Safety Culture Nurses' reports on the quality of nursing care on their unit
Coleman, 2018 [68] New York, United States Hospitals (n = 3) in rural western New York Period: N/A	To investigate a potential relationship between workplace incivility and MNC Descriptive, cross-sectional study	Convenience RNs: 478 (the final sample was 102) Participation: 24.1% Females: 90.2% 25–34 yrs: 33.3%; 35–44 yrs: 26.5%; 55–64 yrs: 13.7% Associate degree in nursing: 58.8% BSN: 34.3% > 6 months to 2 yrs of experience: 16.7%; 2–5 yrs: 19.6%; 5–10 yrs: 25.5%; > 10 yrs: 37.3%	Elements of MNC Reasons for MNC Sources of incivility: inappropriate jokes, hostile climate, free-riding, abusive supervision, gossip/rumours, lack of respect, displaced frustration MISSCARE Survey (Part A and B) Nursing Incivility Scale

Dhaini et al., 2017 [51] Switzerland Swiss nursing homes (n = 162) Period: 2012–2013	1. To assess the prevalence of implicit rationing of direct resident care, including rationing of ADL and of caring, rehabilitation, and monitoring 2. To explore the relationship between care workers' health and presenteeism regarding implicit rationing of care Secondary analysis of data from the Swiss Nursing Homes Human Resources Project	Randomised Care workers: 5,325 (the final sample size was 3,239, with a response rate of 76.6%) Participation: N/A Females: 92.2% RNs: 28.1% Licensed practical nurse: 24.1% Certified nursing assistant: 19.1% Nurse's aide: 28.8% ≤ 30 yrs: 21.4%; 31–40 yrs: 18.2%; 41–50 yrs: 27.6%; > 50 yrs: 32.8% ≤ 5 yrs of experience: 20.6%; 6–10 yrs: 23.1%; 11–15 yrs: 18.7%; 16–20 yrs: 13.2%	Care worker personnel: sociodemographic and professional data, perceptions of health and quality of care Facility profile questionnaire: nursing home facility characteristics Questionnaire on physical health factors: self-reported back pain, joint pain, and headache Self-reported mental health factors: tiredness, sleeplessness, work-related emotional exhaustion Presenteeism: number of days care workers had attended work in spite of feeling ill and unfit Elements of rationed nursing care Basel Extent of Rationing of Nursing Care, nursing home version
Drach-Zahavy & Srulovici, 2019 [42] Israel Internal, surgical, intensive, oncological, operating, psychiatric, paediatric, obstetrics, and emergency units Period: 2017	To examine the mediating role of nurses' personal accountability in the relationships between nurses' personality and MNC Multi-centre cross-sectional study	Snowball RNs: 290 Participation: 100% Females: 71.3% Mean age: 38.63 yrs (SD 9.79 yrs) BSN: 74.2% Mean nursing seniority: 13.44 yrs (SD 9.79 yrs)	Nurse's personality: agreeableness, conscientiousness, neuroticism, extraversion, openness to experience Mediator variable: personal accountability Control variables: nurse and shift characteristics Elements of MNC MISSCARE survey (only Part A) 44-item Big Five Inventory 19-item 3D Accountability Questionnaire
Duffy et al., 2018 [65] United States One community hospital Period: 2017	1. To describe the phenomenon of MNC and evaluate its associations between selected individual and organisational factors 2. To describe the occurrence and extent of MNC types 3. To examine the relationships between nursing staff characteristics and MNC 4. To examine the relationship between the nursing work environment and MNC 5. To examine the relationship between the combination of nursing staff characteristics and nursing work environment and MNC Cross-sectional correlational study	Stratified randomly selected Selected nurses: 201 (138 returned completed surveys) Participation: 74% Females: 97.1% 25–34 yrs: 46.4%; 35–44 yrs: 17.4%; 45–54 yrs: 20.3% BSN: 60.1% < 6 months of experience in current role: 3.6%	Nurse demographic characteristics Reasons for MNC Nurses' perceptions of the work environment: nurse participation in hospital affairs, nursing foundations for quality care; nurse manager ability, leadership, and support of nurses; staffing and resource adequacy; collegial nurse-physician relations; all had acceptable reliability MISSCARE survey (only part A) Practice Environment Scale-Nursing Work Index
Friese et al., 2013 [83] Midwestern United States Oncological and medical/surgical units (n = 62) of nine hospitals in the Midwestern United States Period: 2008–2009	To quantify the degree of MNC in oncology units, compare MNC between oncology and non-oncology medical surgical units, and identify correlates of MNC in oncology units Secondary analysis	Convenience Nurses: 2,318 Participation: 59.8% *Non-oncological versus Oncological units* Females: 91.1% versus 91.6% RNs: 73.4% versus 74.1% 26–34 yrs: 31.5% versus 29.9% 35–44 yrs: 24.1% versus 25.1% Associate degree: 39.7% versus 37.7% BSN: 40.0% versus 42.0% < 5 yrs of experience: 52.2% versus 51.4% 5–10 yrs of experience: 18.5% versus 18.6% > 0 yrs of experience: 29.3% versus 30.0%	Elements of MNC Reasons for MNC Nursing staff characteristics: years of experience, gender, role, education Work schedules: shift, hours worked Staffing: absenteeism, reported workloads, perceived staffing adequacy MISSCARE Survey (Part A and B)
Hernández-Cruz et al., 2017 [90] Mexico Emergency, intensive care, and inpatient services of one private hospital Period: 2015	To determine the factors influencing MNC in hospitalised patients Descriptive and correlational study	Convenience Nurses: 71 Participation: 100% Females: 77.5% Baccalaureate nurses: 93.0% Auxiliary nurses: 7% Mean age: 28.4 yrs (SD 5.61 yrs) 1–2 yrs of work at the services: 47.9% 3–4 yrs of work at the institution: 35.2% 1–5 yrs of professional experience: 62%	Demographic characteristics: gender, age, nursing education, professional experience, number of patients assigned Elements of MNC Reasons for MNC MISSCARE Survey (Part A and B), Spanish version

Hessels et al., 2015 [29] New Jersey, United States Acute care hospitals (n = 70) Period: 2006	To explore the relationship between specific factors of the nursing practice environment and MNC Cross-sectional study	Randomised Nurses: 7,679 Participation: 50% Females: 97% BSN: 44% Specialty certification: 52%	Nurse participation in hospital affairs, nursing foundations for quality care, nurse manager ability, leadership, and support of nurses, staffing and resource adequacy, collegial nurse-physician relations Elements of tasks left undone Control variables: nurse staffing levels, hospital size, teaching status, high technology status, hospital geographic categories, nurse education Practice Environment Scale of the Nursing Work Index Tasks left undone
Higgs et al., 2016 [70] Australia Critical care/emergency specialty, medical, and surgical units in one tertiary referral hospital, Sydney Period: N/A	To determine similarities and differences in elements of nursing care that are commonly rationed in the critical care, medical, and surgical specialties within an acute hospital environment Cross-sectional study	Sampling method: N/A RNs: 249 Participation: N/A *Critical, medical, surgical unit* Females: 81.6%, 88.5%, 93.2% 20–29 yrs: 43.7%, 42%, 44.4% 30–39 yrs: 21.8%, 31.8%, 23.6% 40–49 yrs: 17.2%, 13.6%, 20.8% 50–59 yrs: 14.9%, 8.0%, 5.6% > 60 yrs: 2.2%, 4.5%, 5.6% Less than a BSN: 11.9%, 9.1%, 9.7% BSN: 48.8%, 75%, 80.6% Graduate certificate/diploma: 25%, 9.1%, 8.3% MSN or PhD: 14.3%, 6.8%, 1.4% Mean yrs as RN: 11.5, 7.9, 8.1	Demographic and background variables Elements of MNC MISSCARE scale (only Part A)
Kalisch & Lee, 2010 [52] Midwestern United States Medical/surgical, intermediate, intensive care, and rehabilitation units (n = 50) in four hospitals located in the Midwestern United States Period: 2009	To determine if the presence or absence of nursing teamwork results in MNC, which is any aspect of required patient care that is omitted or significantly delayed Cross-sectional, descriptive study	Convenience Nurses staff members: 2,216 Participation: 59.7% Females: 89.2% RNs: 76.5% NAs: 22.2% Licenses practical nurses: 1.3% < 25 yrs: 14.7%; 26–34 yrs: 28.7%; 35–44 yrs: 26.7%; 45–54 yrs: 21.0%; > 55 yrs: 8.9% High school grad: 14.7% Associate degree: 38.5% BSN: 42.6% Graduate school: 4.2% 6 months to 2 yrs of experience: 23.7%; 2–5 yrs: 19.3%; 5–10 yrs: 17.7%; > 10 yrs: 34.1%	Nursing teamwork: trust, team orientation, backup, shared mental models, team leadership Elements of MNC Demographics: gender, age, education, experience, occupation, work schedules, perceptions of staff adequacy, overtime, absenteeism, staffing adequacy, number of hours of overtime MISSCARE Survey (only Part A) Nursing Teamwork Survey
Kalisch et al., 2011 [36] Midwestern United States Medical/surgical, rehabilitation, intermediate, and intensive care units (n = 110) in 10 acute care hospitals Period: 2008–2009	To examine the relationship between the levels and types of nurse staffing and MNC in acute care hospitals Cross-sectional, descriptive study	Purposive Nurses: 4,288 Participants: 60% Females: 90% RNs: 73.5% > 35 yrs: 53.2% BSN degree or higher: 46.7% > 5 yrs experience: 51.0%	Staff characteristics: age, gender, education, experience in the profession/occupation, occupation, employment status, shift worked and its length, unit type, hours per patient days, registered nurse hours per patient day, skill mix, absenteeism, unit case mix index, work scheduled MISSCARE Survey (only Part A)
Kalisch et al., 2011 [59] Midwestern United States Medical/surgical units, intensive care, intermediate care, and rehabilitation units of 10 hospitals Period: 2008–2009	1. To identify the levels and types of MNC and reasons for MNC across hospitals 2. To examine the relationship between unit staff characteristics (gender, age, education, and experience in the role), work schedules (shift worked, length of shift, weekly worked hours, absenteeism, and unit type), staffing variables (perceived level of adequate staffing and number of patients cared for), and MNC Cross-sectional study	Convenience RNs: 3,143 NAs: 943 Participants: 59.8% (RNs 61.8%; NAs 53.4%) Females: 90% RNs: 77% NAs: 23% Baccalaureate degree or higher: 51% Experience as nurse < 6 months: 5% Experience as a nurse ≥ 10 yrs: 32%	Staff characteristics: education, job experience, gender, age Work schedules: shift, hours worked Staffing: absenteeism, perceived staffing adequacy, patient workloads MISSCARE Survey (Part A and B)

Kalisch & Lee, 2012 [69] Midwestern and Western United States Medical/surgical, intermediate, intensive care, and rehabilitation units (n = 124) in 11 hospitals located in the Midwestern and Western United States Period: 2008–2009	To compare the amount, type, and reasons for MNC at Magnet and non-Magnet hospitals Cross-sectional, descriptive study	Convenience Nursing staff: 4,412 Participation: 57.3% N/A	Magnet status of the hospitals Elements of MNC Reasons for MNC Nursing education Unit characteristics and type Skill mix Experience levels MISSCARE Survey (Part A and B)
Kalisch et al., 2012 [86] Two states, not specified Units (n = 124) of 11 acute care hospitals Period: 2008–2009	To determine whether the omission of elements of nursing care leads to a greater number of patient falls, using actual fall rates and controlling for nurse staffing levels Cross-sectional, descriptive study	Convenience Nurses: 3,432 NAs: 980 Participation: 57.3% Females: 91% > 35 yrs: 54% BSN or higher: 47% > 5 yrs of experience: 51%	Elements of MNC items from the MISSCARE Survey: ambulation, patient assessments each shift, focused reassessment, response to call light, assistance with toileting Hours per patient day Fall rate (number of falls per 1,000 patient days)
Kalisch et al., 2013 [49] Lebanon, Beirut, and Midwestern United States United States: medical/surgical units, intermediate units, and ICUs (n = 14) in one teaching hospital Lebanon: medical/surgical unit, intermediate unit, and ICUs (n = 18) in one teaching hospital Period: N/A	To determine the extent of MNC and causes for it in Lebanon, comparing it with those in the United States Descriptive, cross-sectional study	Convenience U.S. nurses: 633 Lebanese nurses: 114 U.S. participants: 55.1% Lebanese participants: 44.4% *United States versus Lebanon* Females: 90.8% versus 63.5% > 35 yrs: 54.6% versus 8.7% BSN: 56.2% versus 84.3% > 5 yrs of experience: 48.7% versus 42.8% > 10 yrs of experience: 14.4% versus 7.1%	Elements of MNC Reasons for MNC: labour resources, material resources, communication Staffing levels and job satisfaction: number of patients cared for in the last shift, satisfaction with current position, profession and teamwork MISSCARE Survey (Part A and B)
Kim et al., 2018 [41] South Korea One tertiary university hospital Period: 2017	1. To describe the levels of the nursing work environment, perception of the patient safety culture and MNC 2. To identify the influence of the work environment and patient safety culture on MNC Cross-sectional study	Convenience Nurses: 188 (the final sample was 186) Participation: 98.9% Females: 94.6% Staff nurses: 70.7% Charge nurse: 29.3% Mean age: 28.36 yrs Three-year diploma: 17.8% BSN: 82.2% ≥ MSN: 18.4% Mean clinical career: 5.77 yrs	Nursing work environment: nurses' participation in hospital affairs, nursing foundations for quality of care, nurse manager ability, leadership, and support of nurses, staffing and resource adequacy, collegial nurse-physician relations Patient safety culture: perception of patient safety culture, supervisor/manager, perception of communication on patient safety Elements of MNC Practice Environmental Scale of Nursing Work Index Perception of Patient Safety Culture Scale MISSCARE Survey (only Part A)
Labrague et al., 2019 [31] The Philippines Hospitals (n = 6) in the Central Philippines Period: 2018–2019	To examine the predictive role of nurse caring behaviours on MNC, adverse patient events, and the quality of nursing care Cross-sectional study	Convenience RNs: 600 (the final sample was 549) Participation: 91.5% Females: 78.7% Staff nurse: 86.9% Manager nurse: 13.1% Mean age: 29.8 yrs BSN: 91.1% MSN/PhD: 8.9% < 10 yrs in nursing: 81.2%; 10–19 yrs: 12.6%; >2 0 yrs: 6.2%	Caring behaviour of nurses Elements of MNC Adverse patient events: complaints from patients and their families, verbal abuse, falls, nosocomial infections, medication errors Nurse-assessed quality of care Caring Behaviour Inventory MISSCARE survey (developed by Lake et al., 2017) Adverse Patient Events Scale

Liu et al., 2018 [44] China Medical and surgical units (n = 111) in 23 hospitals Period: 2014	To explore the impact of hospital nursing organisational factors, including nurse work environment and workload, nursing care left undone, and nurse burnout, on patient safety in a Chinese context Cross-sectional study	Convenience Nurses: 1,671 Participation: 92.3% Females: 98.8% 18–25 yrs: 40.1%; 25–30 yrs: 30.2%; 30–35 yrs: 16.0%; 35–40 yrs: 6.9%; 40–54 yrs: 6.8% Secondary diploma: 53.2% Advanced diploma: 37.3% Baccalaureate degree and higher: 9.5% < 5 yrs of experience: 52.0%; 5–10 yrs: 22.7%; 10–15 yrs: 12.0%; 15–20 yrs: 6.2%; 20–34 yrs: 7.1%	Demographic characteristics: gender, age, education level, years working in nursing Nurse work environment: nurse participation in hospital affairs, nursing foundation for quality of care, nurse manager ability, leadership, and support of nurses, staffing and resource adequacy, collegial nurse-physician relations Nurses' workload Nursing care left undone Nurse burnout Patient safety: patient safety level, adverse events Practice Work Environment Scale of the Nursing Work Index Maslach Burnout Inventory-Human Services Survey
McNair et al., 2016 [57] California, United States Two hospitals (n = 15 units): University of California, Los Angeles, Santa Monica Medical Center (UCLA-SM) and University of California, San Francisco, Medical Center at Parnassus (UCSF-P) Period: UCLA-SM: 2012–2013 UCSF-P: 2013–2014	1. To examine the degree to which nurses reported that care was missed 2. To measure the time that RNs actually spent on various types of tasks 3. To examine the association between patterns of time use by nurses and reports of MNC at the level of the nursing unit Longitudinal study UCLA-SM: time 1, December 2012; time 2, September 2013 UCSF-P: time 1, April 2013; time 2, February 2014	Randomised Nurses: 669 Participation: 95.5% (639) *UCLA-SM versus UCSF-P* Female: 74.5% versus 73.2% ≤ 30 yrs: 21.7% versus 34.6% 31–40 yrs: 45.0% versus 27.9% 41–50 yrs: 13.1% versus 23.6% 51–60 yrs: 12.5% versus 9.70% ≥ 61 yrs: 1.99% versus 0.84% > 6 yrs of experience: 48.7% versus 62.3%	Staff characteristics: nurse's age, gender, years of nursing experience, use of NAs, numbers of patients cared for during the current shift Elements of MNC MISSCARE Survey (Part A and B)
Menard, 2014 [88] New York, United States Hospitals (n = 3) in rural western New York Period: N/A	To investigate a potential relationship between workplace incivility and MNC Descriptive, cross-sectional study	Convenience RNs: 478 (the final sample was of 102) Participation: 24.1% Females: 90.2% 25–34 yrs: 33.3%; 35–44 yrs: 26.5%; 55–64 yrs: 13.7% Associate degree in nursing: 58.8% BSN: 34.3% > 6 months to 2 yrs of experience: 16.7%; 2–5 yrs: 19.6%; 5–10 yrs: 25.5%; > 10 yrs: 37.3%	Elements of MNC Reasons for MNC Sources of incivility: inappropriate jokes, hostile climate, free-riding, abusive supervision, gossip/rumours, lack of respect, displaced frustration MISSCARE Survey (Part A and B) Nursing Incivility Scale
Nelson, 2017 [62] Northwest Oregon, United States Nursing home facilities (n = 16), both for-profit (n = 14) and non-profit (n = 2), Medicaid and/or Medicare certified Period: 2016–2017	1. To determine the relationships between perceptions of workload, teamwork, and MNC as reported by nursing staff members in nursing home settings 2. To investigate whether teamwork is an operant mechanism through which workload is associated with MNC Cross sectional, descriptive, correlational exploratory study	Convenience Population: 139 Participants: 77.8% Females: 83.5% Charge nurses: 51.8% Staff RNs: 15.1% Staff licensed practical nurses: 25.2% Certified nursing assistants: 7.9% Mean age: 37.1 yrs (SD 10.9 yrs) Associate degree: 46.0% Baccalaureate degree: 39.6% Graduate degree: 2.9% Mean experience in current role: 6.3 yrs (SD 8.1 yrs)	Demographic and other information: age, gender, level of educational preparation, job title, role, experience in current role, unit and employer, sick leave use, overtime, intent to leave position, perception of staffing adequacy, normal shift worked Unit and facility characteristics: number of residents and occupancy rate, profit status, size, staffing levels Elements of MNC Workload: nursing staff's perception of workload as unit, unanticipated patient events, availability of support staff, all related to the past 3 months Teamwork: trust, team orientation, backup, shared mental model, team leadership MISSCARE Survey (only Part A) Workload Subscale of the Individual Perceptions of Workload Scale Nursing Teamwork Survey
Orique et al., 2016 [55] California, United States Acute care medical facility (n = 1) Period: 2014	Identify aspects of MNC and their relationship to unit-level nurse workload: types of MNC, reasons for MNC, types and reasons for MNC influenced by demographic characteristics, relationship between unit-level nurse workload, and incidence of MNC Descriptive study	Convenience RNs: 132 NAs: 25 Licensed vocational nurses: 12 Participation: N/A Females: 85.2% RNs: 78.1% NAs: 14.8% Licensed vocational nurses: 7.1% 25–34 yrs: 36.7%	Staff characteristics: demographic, work schedules, staffing Element of MNC Reasons for MNC MISSCARE Survey (Part A and B)

Palese et al., 2015 [67] Italy Acute medical units (n = 12) Period: 2012	1. To identify the amount, type, and reasons for care being missed in the Italian medical care setting and to explore the factors that affect the occurrence of MNC 2. To describe the demographic and professional profile of nursing staff working in medical units as well as their work satisfaction and intention to leave Mixed-method approach: longitudinal survey and cross-sectional study (daily data collection for a period of three months)	Convenience RNs: 252 NAs: 165 RNs participation: 81.3% NAs participation: 66% Females: 85% < 25 yrs: 7.0%; 25–34 yrs: 28.3%; 35–44 yrs: 37.6%; > 45 yrs: 26.5% Nursing diploma: 42.0% University degree: 51.2% Advanced education: 4.9% 2–5 yrs in current role: 21.7% > 5 yrs in current role: 57.0%	Elements of MNC Reasons for MNC Demographic and professional data: age, gender, education, role occupied, length of experience in the professional role and in the medical ward, working time profile, number of working hours per week, extra hours worked, shifts lost in the last 3 months, the number of patients cared for on the last shift, the number of admitted and discharged patients, intention to leave, satisfaction with the current role, the profession, and the team MISSCARE Survey (Part A and B)
Papastavrou et al., 2014 [8] Cyprus Surgical (n = 211) and internal medicine (n = 156) units from all public general hospitals in Cyprus Period: 2010–2011	To explore the level and aspects of rationing of nursing care, and the potential relationship between nurses' perception of their professional practice environment and rationing Descriptive, correlational, cross-sectional multi-centre study	Convenience Nurses: 715 Participation: 60.6% Females: 71% Mean age: 34.06 yrs Nursing school diploma: 74.5% University degree: 24% MSN: 0.5% Mean experience in nursing: 11.41 yrs (SD 9.27 yrs) Mean experience in current unit: 5.32 yrs (SD 5.47 yrs)	Elements of MNC Reasons for MNC Nurse practice environment: handling disagreement and conflict, internal work motivation, control over practice, leadership and autonomy in clinical practice, staff relationships with physicians, teamwork, cultural sensitivity, communication about patients Demographics: gender, age, educational level, employment status, number of years of experience in nursing Basel Extent of Rationing of Nursing Care Revised Professional Practice Environment scale
Papastavrou et al, 2016 [78] Cyprus All oncology and haematology units (n = 6) in Cyprus Period: 2014	To investigate nursing care rationing in oncology units: elements of care that are most often omitted, causes of MNC, any relationship between nursing care rationing, and intrinsic characteristics of nurses Descriptive, co-relational, cross-sectional study	Convenience RNs: 171 Participation: 91.8% Females: 62.4% 25–34 yrs: 57.3% > 2 yrs of experience: 57.1%	Staff characteristics: gender, age, education, hours of work, work experience, intention to leave, work satisfaction Elements of MNC Reasons for MNC MISSCARE Survey (Part A and B)
Park et al., 2018 [66] United States 1,583 units in acute care hospitals (n = 371) Period: 2015	1. To examine the relationship between the quality of nurse practice environment and MNC 2. To identify which characteristics of the nurse practice environment are more likely to be associated with MNC Descriptive, correlational study	Convenience RNs: 31,650 Participants: 50% N/A	Practice environment for nurses: nurse participation in hospital affairs, nursing foundations for quality of care, nurse manager ability, leadership and support of nurses, staffing and resource adequacy, collegial nurse–physician relations Characteristics of the practice environment Elements of MNC Hospital and unit characteristics: hospital size, teaching status, location, Magnet status, patient case mix, unit type Practice Environment Scale of the Nursing Work MNC based upon the NDNQI RN
Phelan et al., 2018 [63] Ireland Nurses and Midwives Organisation Period: 2015	To examine the prevalence rates of MNC in the community nursing sector Cross-sectional study	Purposive Public Health Nurses: 1,500 (the final sample was 283) Participation: 29% Females: 98% 35–44 yrs: 34% 45–54 yrs: 34% Primary degree or higher: 90% 6–15 yrs of work in community nursing: 59%	Demographic data Components of community nursing: home nursing care, care management, family support, older people, disadvantaged groups, health promotion, education, provision of other community services, primary care teams, administration Elements of MNC Factors affecting MNC Questionnaire based on the MISSCARE Survey (Part A and B)
Piscotty et al., 2014 [89] Midwestern United States Medical, surgical, intensive care, and intermediate care (n = 19) in one acute care hospital Period: N/A	1. To examine relationships between interventions supported by clinical decision support and reduced MNC 2. To examine relationships between nurses' perceptions of health care information technology on their work and their reports of MNC Descriptive study	Convenience RNs: 165 Participation: 100% Female: 87.9% < 25 yrs: 13.9%; 25–34 yrs: 37.0%; 35–44 yrs: 23.0%; 45–54 yrs: 15.8%; 55–64 yrs: 9.7%; > 65 yrs: 0.6% Associate degree: 26.7% BSN: 69.1% Graduate degree: 4.2% < 6 months of experience: 4.8%; 6 month to 2 yrs: 24.2%; 2–5 yrs: 21.2%; 5–10 yrs: 13.9%; > 10 yrs: 35.8%	Nursing care reminders Elements of MNC Reasons for MNC Demographics Nursing care reminder usage survey Impact of Healthcare Information Technology Scale MISSCARE Survey (Part A and B)

Saqer et al., 2018 [87] Jordan Two governmental hospitals and two private hospitals Period: 2016	1. To identify the types and reasons for MNC among Jordanian hospital nurses 2. To identify predictors of MNC based on background variables, confidence in delegation, and perceived reasons for MNC 3. To examine the relationship between nurses' confidence in delegation and MNC Cross-sectional study	Convenience Nurses: 362 Participation: 78.1% Females: 55.2% Mean age: 29.5 yrs BSN: 87.6% MSN: 12.4% ≤ 6 yrs of nursing experience: 50%	Elements of MNC Reasons for MNC Demographic factors (e.g. age, gender) and models of care delivery Relationship between nurse confidence in delegation and MNC Shift schemes (mixed shift, 8-hour or 12-hour shifts) MISSCARE Survey (Part A and B) The confidence and intent to delegate subscale
Schubert et al., 2013 [38] Switzerland Acute care hospitals (n = 35) from the German, French, and Italian language regions Period: 2009–2010	1. To describe the levels of implicit rationing of nursing care in a quota sample of Swiss acute care hospitals 2. To explore the assumed associations between the quality of the nurse work environment dimensions, patient-to-nurse ratio, number of patients requiring support in all ADLs, number of patients requiring hourly or more frequent monitoring, patient safety climate, nurse experience, and education and implicit rationing of nursing care Sub-study of the cross-sectional, multi-centre RN4CAST study, specifically the Swiss part	Convenience RNs: 2,280 Participation: 71.6% Females: 90% Mean age: 35 yrs (SD 9.89 yrs) BSN/MSN: 10% Mean experience as a nurse: 8.00 yrs (SD 14.81 yrs) Mean experience in this hospital: 5.00 yrs (SD 10.17 yrs)	Quality and elements of the nurse practice environment: nurse participation in hospital affairs, staffing and resources adequacy, nurse foundations for quality of care, nurse manager ability, leadership support of nurses, collegial nurse–physician relations Patient-to-nurse staffing ratio Nurse characteristics: experience, qualification, age, sex, employment status Hospital characteristics: typology, size Revised version of Basel Extent of Rationing of Nursing Care instrument Practice Environment Scale of the Nurse Work Environment Index-Revised Safety Organizing Scale
Siqueira et al., 2017 [35] Brazil One large-scale teaching hospital Period: N/A	To validate the MISSCARE BRASIL survey Methodological and cross-sectional study	Simple randomisation Nursing professionals: 330 Participation: N/A Females: 77.3% Aides: 39.7% Technicians: 33% Nurses: 20.9% Nurses with administrative roles: 6.4% Mean age: 39.9 yrs Secondary education: 55.5% Nursing technician school: 42.4% > 10 yrs at the job: 52.1% > 5 yrs of experience in the inpatient sector: 54.8%	Elements of MNC Factors affecting MNC MISSCARE Survey (Part A and B)
Smith et al., 2018 [71] United States Magnet (n = 3) and Pathway to Excellence (n = 2) to Excellence hospitals Period: 2015	1. To describe the frequency of MNC in a multi-hospital U.S. sample 2. To determine the relationship between nurse work environments and MNC 3. To explore the association of the nurse work environment and collective efficacy with MNC Quantitative, cross-sectional study	Convenience RNs: 283 Participation: 8.1% Females: 93% 20–25 yrs: 13%; 26–30 yrs: 22%; 31–40 yrs: 25%; 41–50 yrs: 20%; 51–75 yrs: 20% < 1 year of experience: 12%; 1–2 yrs: 31%; 3–5 yrs: 18%; 6–10 yrs: 18%; 11–15 yrs: 10%; 16–20 yrs: 6%; >20 yrs: 5% Associate degree: 18% BSN: 74% MSN: 6%	Demographics: age, years of experience on the unit, unit specialty Nurse work environment: nurse manager ability, leadership, and support of nurses, nurse staffing and resource adequacy, nursing foundations for quality of care, nurse participation in hospital affairs, collegial nurse–physician relations Elements of MNC Collective efficacy Practice Environment Scale of the Nurse Work Index MISSCARE Survey (only Part A) The Collective Efficacy Beliefs Scale
Srulovici et al., 2017 [43] Israel Different nursing units (internal medicine, surgery, intensive care, oncology, operating wards, psychiatry, paediatrics, obstetrics, and emergency units; n = 32) of eight public hospitals Period: 2016	To test the joint effects of personal and ward accountability on MNC, by using both focal (a nurse whose MNC is examined) and incoming (a nurse responsible for the same patients during the subsequent shift) nurses' assessments of MNC Cross-sectional study	Snowball RNs: 172 Participation: 100% Females: 75% Mean age: 38.98 yrs (SD 9.58 yrs) BSN: 69.78% Mean professional experience: 13.93 yrs (SD 9.48 yrs)	Elements of MNC Personal and organisational accountability Nurse characteristics: age, gender, educational qualification, professional seniority, employment status Workload: patient to nurse index, complexity of patients during the shift MISSCARE survey (only part A)

VanFosson et al., 2018 [53] United States One 16-bed intensive care unit and one 24-bed progressive care unit of the U.S. Army Burn Center Period: one week per month for six months	1. To describe the monthly variation in the prevalence and patterns of unfinished nursing care 2. To determine the relationships between the nursing care system and unfinished nursing care Repeated measures descriptive study	Convenience Nurses: 118 (599 surveys) Participation: 44.9% Females: 66% Licensed vocational nurses: 19% RNs: 81% Advanced individual training only: 1% Some college: 16% Associate degree: 28% BSN: 49% MSN: 6% 3 yrs of experience: 4%; 3–10 yrs: 35%; > 10 yrs: 61%	Demographics: unit type, shift worked, employment category, supply/demand ratio, patient turnover, overtime paid Unfinished nursing care Perceived Implicit Rationing of Nursing Care survey instrument
Vryonides et al., 2016 [77] Cyprus All oncology and haematology units (n = 6) in Cyprus Period: 2014	1. To determine the different ethical climate types that are identified by nurses in cancer care units 2. To determine which type of ethical climate is prevalent 3. To investigate and describe the relationship (if any) between the identified types of ethical climates in cancer care units and the nurses' perceived level of MNC Descriptive correlation study	Convenience RNs: 171 Participation: 91.8% Females: 62.4% < 34 yrs: 60.5% BSN: 82.8% MSN or PhD: 12.7% Diploma: 4.5% > 5 yrs of experience: 66.2%	Demographics: gender, age, workplace/care unit, level in nursing education, clinical experience Ethical climate: caring, instrumental, independence, law and code, rules Elements of MNC Ethical Climate Questionnaire MISSCARE survey-nurses version (only Part A)
White et al., 2019 [91] California, Florida, Pennsylvania, and New Jersey, United States Nursing homes (n = 540) Period: 2015	To examine how burnout and job dissatisfaction contribute to the likelihood of nursing home RNs leaving necessary care undone Cross-sectional secondary study	Randomised RNs: 231,000 Participation: 26% Females: 92.7% Mean age: 49.1 yrs Hospital diploma: 14.8% Associate degree: 46.7% BSN: 36.0% MSN or higher: 1.3% Mean RNs experience: 16.6 yrs	Burnout Job dissatisfaction: degree to which RNs were satisfied with their primary job and specific job aspects, health care, retirement, tuition benefits, salary/wages, work schedule, opportunities for advancement, independence at work, professional status Elements of MNC Nurse characteristics: age, years of RN experience, sex, race, native language, and highest nursing degree Nursing home characteristics: ownership type, chain affiliation, bed size, payer mix, staffing measures for RNs, licensed practical nurses, certified nursing assistants Emotional Exhaustion subscale of the Maslach Burnout Inventory MNC: nurses were asked to identify from a list of 14 care activities which, if any, were necessary but left undone due to lack of time or resources on their most recent shift/day worked
Winsett et al., 2016 [82] United States Medical, surgical, or combined medical/surgical units (n = 18) in four non-academic medical centres Period: 2014	1. To examine the nurse work environment by evaluating the self-reported MNC and reasons for MNC from nurses on medical surgical units 2. To describe the frequency and reasons for MNC 3. To describe the relationships among the unit types for frequency of MNC Descriptive correlational study	Convenience Nurses: 586 Participation: 29% Age: 36 ± 12.6 yrs BSN: 40.5% Diploma: 7.1% MSN: 4.2% 6 months to 2 yrs of experience: 28.6%; > 10 yrs: 33.4% 6 months to 2 yrs in current unit: 34.0%; > 10 yrs: 22.0%	Demographic characteristics: age, educational degree, primary shift worked, staffing adequacy, usual number of hours worked per week, overtime hours and missed shifts in the previous three months, number of patients assigned during last shift worked with number of admissions and discharges Unit characteristics: total unit full time equivalents, RN hours per patient day, case mix index, skill mix Element of MNC Reasons for MNC MISSCARE Survey (Part A and B)
Zander et al., 2014 [84] Germany Hospitals (n = 49) Period: 2009–2011	To describe the prevalence and patterns of nursing care left undone as well as its association with the nurse work environment and staffing in German acute care hospitals (as part of the RN4CAST Study) Cross-sectional, descriptive study	Convenience Professional nurses: 1,511 Participation: 44% Females: 89.3% More than 10 yrs of professional experience: 68.6% Average yrs of experience: 10.3 yrs	Quality of nurse work environment Nurse staffing level Nurse factors: age, gender, employment level; level of emotional exhaustion RN4CAST nurse questionnaire

Zhu et al., 2019 [43] China Hospital medical and surgical units (n = 181) from nine provinces, municipalities, and autonomous regions in mainland China Period: N/A	To explore the interrelationships among the different aspects within nursing work systems using structural equation modelling Cross-sectional study	Convenience Nurses: 7,802 Patients: 5,430 Participation: N/A Female nurses: 99.50% Mean nurse age: 29.42 yrs Mean working yrs as a nurse: 8.73 Secondary diploma (nurses): 18.41% Advanced diploma (nurses): 61.28% BSN higher (nurses): 20.31% Mean patient age: 54.24 Mean patients length of stay: 14.83 days	Patient outcome indicators: nurse-reported quality assessments, patient adverse events, patient-reported dissatisfaction with hospital care Rationing of nursing care: comfort/talk with patients, teach/counsel patients and family, adequate patient surveillance, prepare patients and families for discharge, coordinating patient care, develop or update nursing care pans, skin care, pain management, adequately document nursing care, oral hygiene, treatments and procedures, administer medications on time Characteristics of hospital organisation and unit type Nurses education and working time Patient demographics: length of stay, self-rated health status, educational level China Nurse Survey Basel Extent of Rationing of Nursing Care
Zúñiga et al., 2015 [50] Switzerland Nursing home facilities from all three language regions in Switzerland (n = 156), nursing home facilities (n = 402), and teams not bound to a specific unit (n = 74) Period: 2012–2013	1. To describe levels and patterns of self-reported implicit rationing of care 2. To explore the relationship between staffing level, turnover, and work environment factors and implicit rationing of nursing care Sub-study of the Swiss Nursing Home Human Resources Project	Random Care workers: 4,307 Participation: 78% Females: 92.3% RNs: 25.3% Licensed practical nurses: 21.5% Certified assistant nurses: 19.8% Nurse's aides: 30.1% Other 3.3%	Elements of implicit rationing of nursing care Leadership: nurse manager ability, leadership, support of care workers Staffing and resources adequacy Teamwork and resident safety climate Work stressors: workload, conflict and lack of recognition, lack of preparation Demographics: gender, age, usual shift, educational background Unit characteristics Resident characteristics: age, length of stay, resident care load Basel Extent of Rationing of Nursing Care instrument Two subscales of the Practice Environment Scale–Nursing Work Index The Safety Attitudes Questionnaire Health Professions Stress Inventory
Cohort studies			
Griffiths et al., 2018 [32] England Adult medical and surgical wards (n = 32) of a large acute general hospital Period: 2012–2015	1. To determine whether adverse outcomes occur after patients are exposed to low nurse staffing levels on hospital wards, and whether missed observations mediate this relationship and could thus provide a useful indicator of inadequate staffing levels 2. To examine whether, and how, variation in nurse staffing levels on general hospital wards is associated with omissions or delays in delivering necessary nursing care 3. To model the possible costs and consequences of changes in staffing levels 4. To provide a basis for identifying the nurse staffing levels and skill mix required to ensure adequate patient surveillance, and to assess whether rates of missed vital signs observations can be used to identify when or where care is falling below accepted standards and putting patients at risk Retrospective, longitudinal observational study (time 0, admission date; ending time, indicator for death)	Convenience Patients: 138,133 (294,5265 complete observations) Participation: N/A Females: 53% Mean age: 67 yrs (SD 20.61 yrs) < 65 yrs: 47%; 65–74 yrs: 18%; 75–85 yrs: 21%; ≥ 85 yrs: 14% Patients died: 4.1% Average skill mix: 60% RN	Adverse event outcome: death, cardiac arrest or unplanned ICU admission Missed observations Vital signs observations Nutritional risk assessments Nursing staff data Nutritional risk with Malnutrition Universal Screening Tool National Early Warning Score
Hogh et al., 2018 [30] Denmark Municipalities: eldercare sector (n = 10) Period: time 1, 2006; time 2, 2008	1. To analyse the long-term impact of bullying among health care providers (time 1) on MNC and quality of care 2 yrs later (time 2) 2. To test the potential mediating effect of affective organisational commitment Prospective cohort study (time 1 and time 2)	Convenience Health care providers engaged in provision of care: 4,000 at time 1 clustered; N/A at time 2 Females: 97.6%	Bullying: if respondents had been exposed to bullying within the past 12 months and how often Mediator Covariates: place of work, tenure at current job, professional level MNC with a two-item scale ('How often does it happen that the allocated time is not sufficient to meet the needs of the client?' and 'How often do you have to finish a visit with a client with the feeling that you have not done what was necessary?')
Knopp-Sihota et al., 2015 [31] Canada Nursing homes (n = 36) Period: 2010	1. To describe the nature and frequency of rushed or missed care by health care aides 2. To assess the association of rushed or missed care with care aide characteristics or work characteristics such as organisational context at the nursing home microsystems level Longitudinal study	Random stratified Health care aides: 583 Participation: N/A Females: 94.2% < 30 yrs: 13.0%; 30–39 yrs: 22.3%; 40–49 yrs: 32.1%; 50–59 yrs: 23.7%; > 60 yrs: 8.9% Mean yrs worked as a care aide: 11 (SD 8.7)	Demographic variables: age, sex, years worked as care aide, shift worked most often Job satisfaction and vocational satisfaction Mental and physical health status Burnout Organisational context: province, location, size and owner/operator model Outcome variables: times felt rushed and missed resident care Missed Resident Care SF-8™ Health Survey Maslach Burnout Inventory Alberta Context Tool Missed Resident Care
Quasi-experimental study			

Kalisch et al., 2013 [34] United States Medical/surgical units (n = 3) in three acute care hospitals Period: N/A	To test the impact of a train-the-trainer intervention on the level of satisfaction with nursing teamwork and the amount of MNC Quasi-experimental study (time 1, time 2, and time 3 are the pre-test, post-test, and 2 months after completion of the intervention, respectively)	Convenience Nursing staff: 242 Participation: 83.1% for the pre-test surveys, 84.4% for the post test, 73.3% for the follow-up Females: 89.5% RNs: 65% NAs: 30% Unit secretaries: 4% Nursing/assistant manager: 1.7% Licensed practical nurses: 1.2% Age > 45 yrs: 32.5% Licensed practical nurse diploma: 3.6% RNs diploma: 6.6% Associate degree: 29.9% BSN: 49.1% Bachelor outside of nursing: 6.0% MSN or higher in nursing: 4.8% < 6 months of experience: 7.5%; 6 months to 2 yrs: 14.1%; 2–5 yrs: 19.1%; 5–10 yrs: 26.1%	Nursing teamwork: trust, team orientation, backup, shared mental models, team leadership Satisfaction with teamwork Knowledge of teamwork Elements of MNC Nursing Teamwork Survey MISSCARE Survey (Part A and B) Knowledge of Teamwork modification of the knowledge test contained in the Agency of Healthcare Research and Quality Team STEPPS instructor guide

Abbreviations: ADL: activity of daily living; BSN: bachelor of science in nursing; CI: confidence interval; GED: general equivalency diploma; ICU: intensive care unit; IRR: incident rate ratio; MNC: missed nursing care; MSN: master of science in nursing; NA: nursing assistant; NDNQI: National database of Nursing Quality Indicators; N/A: not available; PhD: doctor of philosophy; RN: registered nurse; RN4CAST: Registered Nursing Forecasting; SD: standard deviation; yrs: years.

Supplementary file 2

Quality assessment of included studies: critical appraisal tool for analytical cross-sectional studies [26]

	Al-Kandari et al., 2009 [54]	Ausserhofer et al, 2014 [46]	Ball et al., 2014 [39]	Ball et al., 2016 [85]	Ball et al., 2018 [47]	Bekker et al., 2015 [58]	Blackman et al., 2014 [37]	Blackman et al., 2017 [48]	Blackman et al., 2018 [60]	Blackman et al., 2019 [11]	Bragadóttir et al., 2016 [64]	Castner et al., 2014 [56]	Chapman et al., 2016 [61]	Cho et al., 2015 [81]	Cho et al., 2016 [40]	Coleman, 2018 [68]	Dhaini et al., 2017 [51]	Drach-Zahavy & Srulovici, 2019 [42]	Duffy et al., 2018 [65]	Friese et al., 2013 [83]	Hernández-Cruz et al., 2017 [90]	Hessels et al., 2015 [29]	Higgs et al., 2016 [70]	Kalisch et al., 2010 [52]	Kalisch et al., 2011 [36]	Kalisch et al., 2011 [59]	Kalisch & Lee, 2012 [69]
Item 1. Were the criteria for inclusion in the sample clearly defined?	U	Y	Y	U	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y	U	U	N	N	N	Y	Y	Y
Item 2. Were the study subjects and the setting described in detail?	N	Y	Y	U	Y	Y	U	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	U	N	U	N	Y	Y	Y	Y
Item 3. Was the exposure measured in a valid and reliable way?	N	Y	Y	U	N	N	Y	Y	Y	Y	Y	Y	Y	U	U	Y	Y	U	Y	N	Y	Y	N	Y	N	N	Y
Item 4. Were objective, standard criteria used for measurement of the condition?	N	Y	Y	Y	Y	Y	Y	U	U	U	U	Y	Y	N	Y	Y	Y	Y	U	N	N	Y	U	Y	Y	Y	Y
Item 5. Were confounding factors identified?	N	Y	N	N	U	N	N	N	U	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	U	N	N	N
Item 6. Were strategies to deal with confounding factors stated?	NA	Y	N	N	NA	N	NA	NA	U	NA	N	NA	N	NA	N	N	Y	NA	NA	N	NA	Y	N	Y	N	NA	NA
Item 7. Were the outcomes measured in a valid and reliable way?	N	Y	Y	Y	N	U	Y	Y	Y	U	Y	Y	Y	Y	U	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	U
Item 8. Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Abbreviations: Y: yes; N: no; U: unclear; NA: not applicable.

‡Sampling, data collection, and data management were reported elsewhere.

	Kalisch et al., 2012 [86]	Kalisch et al., 2013 [49]	Kim et al., 2018 [41]	Labrague et al., 2019 [31]	Liu et al., 2018 [44]	McNair et al., 2016 [57]	Menard, 2014 [88]	Nelson, 2017 [62]	Orique et al., 2016 [55]	Palese et al., 2015 [67]	Papastavrou et al., 2014 [8]	Papastavrou et al, 2016 [78]	Park et al., 2018 [66]	Phelan et al., 2018 [63]	Piscotty et al., 2014 [89]	Saqer et al., 2018 [87]	Schubert et al., 2013 [38]	Siqueira et al., 2017 [35]	Smith et al., 2018 [71]	Srulovici et al., 2017 [43]	VanFosson et al., 2018 [53]	Vryonides et al., 2016 [77]	White et al., 2019 [91]	Winsett et al., 2016 [82]	Zander et al., 2014 [84]	Zhu et al., 2019 [43]	Zúñiga et al., 2015 [50]
Item 1. Were the criteria for inclusion in the sample clearly defined?	Y	U	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	N	U‡	Y	U	N	Y
Item 2. Were the study subjects and the setting described in detail?	Y	Y	N	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	U	Y	Y	Y	N	U‡	Y	Y	Y	Y
Item 3. Was the exposure measured in a valid and reliable way?	Y	N	Y	NA	Y	N	Y	Y	U	Y	U	N	Y	NA	Y	U	Y	NA	Y	Y	N	N	N	N	U	N	Y
Item 4. Were objective, standard criteria used for measurement of the condition?	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	U	Y	NA	Y	N	Y	Y	Y	Y	Y	U	Y	U	U	Y	Y
Item 5. Were confounding factors identified?	N	N	N	N	N	N	U	N	N	N	U	N	U	N	N	N	Y	NA	N	N	N	N	N	N	Y	Y	Y
Item 6. Were strategies to deal with confounding factors stated?	N	N	NA	NA	N	NA	U	N	N	N	Y	N	NA	N	N	NA	Y	NA	N	NA	NA	N	NA	N	Y	Y	Y
Item 7. Were the outcomes measured in a valid and reliable way?	N	Y	Y	U	Y	N	Y	Y	Y	Y	U	Y	N	U	Y	Y	Y	NA	Y	Y	Y	Y	U	Y	N	Y	Y
Item 8. Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	Y	Y

Abbreviations: Y: yes; N: no; U: unclear; NA: not applicable.
‡Sampling, data collection and data management were reported elsewhere.

Supplementary file 3

Quality assessment of the included studies: critical appraisal tool for cohort studies [27]

	Griffiths et al., 2018 [32]	Hogh et al., 2018 [30]	Knopp-Sihota et al., 2015 [31]
Item 1. Were the two groups similar and recruited from the same population?	NA	Y	Y
Item 2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?	NA	Y	U
Item 3. Was the exposure measured in a valid and reliable way?	Y	N	Y
Item 4. Were confounding factors identified?	Y	Y	N
Item 5. Were strategies to deal with confounding factors stated?	Y	Y	NA
Item 6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	NA	NA	NA
Item 7. Were the outcomes measured in a valid and reliable way?	Y	N	U
Item 8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?	NA	Y	NA
Item 9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	NA	Y	NA
Item 10. Were strategies to address incomplete follow up utilised?	NA	N	NA
Item 11. Was appropriate statistical analysis used?	Y	Y	Y

Abbreviations*:* Y: yes; N: no; U: unclear; NA: not applicable.

Supplementary file 4

Quality assessment of the included studies: critical appraisal tool for quasi-experimental studies (non-randomised experimental studies) [28]

	Kalisch et al., 2013 [34]
Item 1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	Y
Item 2. Were the participants included in any comparisons similar?	Y
Item 3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	NA
Item 4. Was there a control group?	N†
Item 5. Were there multiple measurements of the outcome both pre- and post-the intervention/exposure?	Y
Item 6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	Y
Item 7. Were the outcomes of participants included in any comparisons measured in the same way?	Y
Item 8. Were outcomes measured in a reliable way?	Y
Item 9. Was appropriate statistical analysis used?	Y

Abbreviations: Y: yes; N: no; U: unclear; NA: not applicable.
†An independent control group was not involved in the study.