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Magnet4Europe Intervention to Improve Clinician and Patient Well-Being

A Quasi-Experimental Study of 56 Hospitals in 6 European Countries

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Background: Descriptive studies have documented high hospital nurse burnout and turnover but there are few, if any, large-scale evaluations of organizational interventions to improve clinician retention. The Magnet model is an organizational hospital intervention associated with better clinician and patient outcomes but there is insufficient evidence as to whether the Magnet model based on structural empowerment of clinicians results in better outcomes or rewards hospitals with good work environments, and whether the Magnet model can be implemented at scale outside the United States.

Objective: To evaluate whether Magnet4Europe—a multiyear organizational intervention of European hospitals—could be implemented and would result in improvements in nurse well-being, care quality, and patient safety.

Design: Quasi-experimental longitudinal evaluation of 56 European intervention hospitals in 6 countries. Hospital-level implementation of the intervention measured by changes (from baseline to follow-up) in 77 Magnet model intervention targets. Outcome measures (eg, nurse burnout, intent to leave, quality of care, patient safety) were derived from surveys of nurses (4546 nurses at baseline; 3171 at follow-up).

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This study was approved by research ethics committees at KU Leuven, Belgium, the University of Pennsylvania, and in participating countries either through a central or decentralized authority.

The authors declare no conflict of interest.

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Findings: Hospitals that implemented intervention targets during the study period observed reductions in nurse burnout, nurses' intentions to leave their jobs, and unfavorable care quality. Each 10-percentage-point increase in intervention target implementation was associated with 2.7%-point reduction in nurses who intend to leave (β −2.66; 95% CI: −4.74, −0.58, $P < 0.05$). Hospitals which implemented more than 25% of intervention targets observed 6.3%-point reduction in nurse burnout, 7.6%-point reduction in intent to leave, 6.4%-point reduction in unfavorable care quality, and 3.7%-point reduction in unfavorable patient safety. Improvements in hospital percentages of nurses reporting staffing adequacy were associated with reductions in burnout, intentions to leave, unfavorable care quality, and patient safety.

Conclusion: Successful implementation of Magnet4Europe demonstrates promise for international adoption at scale of Magnet as an organizational intervention for improving clinician well-being, care quality, and patient safety.

Key Words: hospital, clinician , wellbeing, burnout.

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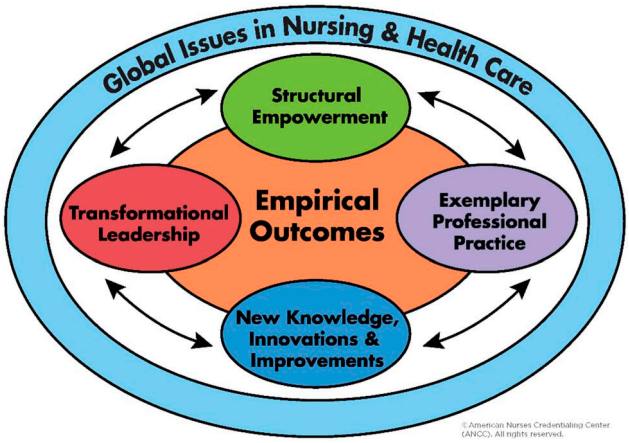

FIGURE 1. The Magnet Model®. Notes. The Magnet Model® *is a trademark of American Nurses Credentialing Center registered in the United States of America and other jurisdictions and is being used under license from ANCC. All rights are reserved by ANCC. ANCC's consent to the use of* The Magnet Model® *mark shall not be construed as ANCC sponsoring, participating, or endorsing the Project.*

Burnout among physicians and nurses is a well-documented crisis.[1–3] Even before the Covid-19 pandemic, the National Academy of Medicine (NAM) launched the Action Collaborative on Clinician Well-Being and Resilience, summarizing evidence that burnout among health professionals was a problem threatening health professional shortages and patient safety. The Covid-19 pandemic further exacerbated clinician burnout.[4–6] The 2023 WHO Europe resolution "Time to Act"[7] and the 2024 NAM National Plan for Health Workforce Well-Being[8] highlighted the urgent need to identify, test, and implement effective interventions to improve clinician well-being.

The Magnet model is an organizational intervention shown to be successful in improving clinician well-being (eg, reducing burnout, intent to leave, and turnover) and patient outcomes (eg, improving patient satisfaction, risk-adjusted mortality).[9–11] The Magnet model (Fig. 1) emerged from research to determine why some hospitals had a waiting list for nurse employment while others in the same labor market had high vacancy and turnover.[12] The identified organizational features associated with low nurse turnover and vacancy rates included structural empowerment of clinicians to participate in organization decision-making, transformational leadership, use of empirical evidence to evaluate outcomes, and investment in the expertise of the hospital workforce, which were operationalized as key components of the Magnet model. Some 10% of US hospitals are now Magnet recognized but Magnet has been slow to disseminate internationally despite evidence that hospital nurses globally are experiencing high burnout and job dissatisfaction, contributing to clinician shortages.[4,13–19]

There have been few, if any, large-scale interventions shown to successfully improve clinician well-being, retention, and patient safety that would offer health care leaders confidence to pursue major organizational change. Most interventions to improve clinician well-being focus on improving coping skills of clinicians (eg, individual resilience training, meditation), rather than improving the organizations where clinicians practice.

Magnet4Europe[20] is the largest example to date of a multicountry intervention trial aimed at improving clinician well-being and patient care quality and safety by prospectively modifying hospital work environments and culture. The Magnet model is operationalized by the American Nurses Credentialing Center (ANCC) in detailed manuals that serve as blueprints for aspiring organizations. The intervention included use of ANCC Magnet tools and manuals to operationalize organizational change, 1:1 twinning with a US Magnet hospital involving monthly phone conferences, access to a Europe-based network of peer hospitals also implementing the intervention, learning collaboratives remotely every 2 months, and annual in-person conferences and exchange visits.

This paper reports on the implementation of the Magnet4Europe intervention in 56 general acute-care hospitals in Belgium, England, Germany, Ireland, Sweden, and Norway, and the impact of the intervention on nurses' well-being (eg, burnout, intent to leave, engagement in work, control over workload) and care quality and patient safety. There has never before been an organizational change project involving 56 volunteer hospitals in multiple counties that agree to implement a common organizational change intervention and participate in a rigorous research protocol to determine the extent of intervention implementation and outcomes as-

sociated with the intervention. Published results from the preintervention survey[14] in Magnet4Europe hospitals showed 25% of nurses were experiencing high burnout, 33% of nurses intended to leave their positions, and most nurses ranked improving nurse staffing and work environments as the interventions most important to reducing their burnout. This analysis evaluates the results of the Magnet4Europe intervention in improving nurse well-being and patient care quality and safety.

METHODS

Design

This is a quasi-experimental prospective evaluation of an organizational intervention originally implemented in 65 European hospitals. The intervention, planned for 4 years, began in January 2020. The coinciding Covid-19 pandemic resulted in delays in obtaining approvals from human subject committees for baseline surveys and travel bans, which necessitated parts of the intervention (eg, twinning, learning collaboratives, and network meetings) to take place remotely for the first 2 years. Required adaptations resulted in a quasi-experimental design where each of the intervention hospitals served as its own control, and in effect, the full Magnet4Europe intervention period was reduced to 2 years, with outcomes data collection taking place in the 2-year period between 2022 and the end of 2023 due to funding constraints.

Study Sample

The final study sample included 56 hospitals from 6 European countries with all required data at both baseline and follow-up period. Hospitals were enrolled in the intervention through announcements in each country soliciting volunteers among general acute hospitals of 100 beds or more. Intervention and US twinning hospitals did not receive financial support for participation. Within each European intervention hospital, we conducted anonymous online surveys of nurses in direct care positions in early 2022 and follow-up at the end of 2023. Per hospital, an average of 83 (baseline) and 58 nurse respondents (at baseline and follow-up, respectively) reported on nurse well-being, patient safety, staffing adequacy, and work environments. Nurses' responses were aggregated to the hospital level since hospitals are the analytic unit of our study.

Study Data and Measures

Predictors

The primary predictor variable was the extent of implementation of the Magnet4Europe intervention, operationalized as the percentage-point change over time in full implementation of 77 Magnet model intervention targets. Intervention targets were measured using the Magnet4Europe Gap Analysis tool adapted with permission from the American Nurses' Credentialing Center (ANCC), and consisted of 77 intervention target items reflecting organizational readiness to apply for Magnet Recognition.[21] The items relate to ANCC Magnet credentialing components: (1) structural empowerment of clinicians, (2) transformational leadership, (3) exemplary practice, (4) new knowledge, innovations, and improvements, and (5) empirical outcomes. Each item was scored on a 4-point scale from 0 = no development; 1 = in planning and development but no implementation; 2 = dissemination in process; 3 = fully enculturated throughout organization. Examples of intervention targets include: an accessible chief nursing officer; clinical nurses are involved in decision-making; physicians and nurses have good relations; nurse and patient satisfaction data are available to inform decisions. Scoring of each item was completed by the intervention hospitals' project teams at baseline and follow-up. Intervention hospitals received training in learning collaboratives and twinning partnerships in how to assess and score the gap analysis.

A secondary predictor variable analyzed was change in "staffing adequacy" measured at the hospital level as the percentage-point change in nurses' reports of staffing adequacy from baseline to follow-up. Staffing adequacy was measured through surveys of direct care nurses in the intervention hospitals at both time points. Survey details are published elsewhere.[14,20,22]

Nurses responded on a 4-point scale to the statement that their work setting has: *Enough nurses to get the work done.* Responses of agree or strongly agree were aggregated to the hospital-level to create a continuous variable.

Outcomes

The following outcome measures were obtained from surveys of nurses at both time points. For each measure and at each time point (baseline, follow-up), individual responses from nurses working in the same hospitals were aggregated by taking the average of the responses to create a hospital-level outcome measure. Hospital-level change over time was calculated as the difference between the follow-up and baseline measure.

Nurse well-being. Burnout was operationalized by the 9-item emotional exhaustion subscale of the Maslach Burnout Inventory. Scores ≥ 27 indicated high burnout.[23] Overall health was derived from a validated global health rating single item from the Short Form-8 Health Survey (SF-8).[24] Sleep quality was derived from a single item from the Pittsburgh Sleep Quality Index.[25] Work-life balance was measured by nurses' responses to the statement on a 4-point scale *My work leaves enough time for my personal and/or family life*; responses of Disagree and Strongly Disagree were categorized as having poor work-life balance.

Nurses who responded affirmatively to the question: "*If possible, would you leave your current hospital within the next year as a result of job dissatisfaction?*" were categorized as having an intent to leave their employer. Nurses responded to a single-item question as to whether they would recommend their hospital as a good place to work. Nurses were asked about the extent to which they feel involved with their hospital and team. Nurse engagement in work was defined as 'low' if the nurse re-

sponded Never or Seldom (on a 5-point scale) to any of 3 items from the Utrecht Work Engagement Scale.[26]

Control over workload. Nurses were evaluated as having less control over their workload if they responded Often or Always on a 5-point scale to statements about having to work very fast, being interrupted, and having to do many tasks simultaneously. Nurses were defined as being frequently interrupted/delayed by operational failures if they reported their work was frequently affected by issues like missing supplies, broken equipment, documentation system problems, or insufficient staff.[27] Teamwork was measured by a single item about whether my team works efficiently together.

Quality of care and patient safety. Missed care was defined using nurse responses about which nursing care activities were necessary but left undone because of time constraints during their most recent shift, including patient surveillance, educating patients and family, and administering medications on time.[28] Quality of care was operationalized using the single-item question:[29] *In general, how would you describe the quality of nursing care delivered to patients on your unit?* Nurses gave their unit/ward an overall grade on patient safety.[29] A summary score of patient safety culture was derived from the average of nurse responses to 6 items on the Agency for Healthcare Research and Quality (AHRQ) Hospital Survey on Patient Safety Culture.[29]

Statistical Analyses

Bar charts describe the distribution of hospitals with respect to change, between 2021 and 2023, in the percentage of fully implemented intervention targets (Gap Analysis items) (Fig. 2), the total percentage of intervention targets fully implemented at follow-up (Fig. 3), and the change in the percentage of nurses within the hospital reporting that nurse staffing is adequate (Fig. 4). In figures, colors are used to represent country differences. Pearson correlation was conducted to evaluate the association between the 2 study predictor variables: percentage-point change in fully implemented intervention targets and percentage-point change in nurse staffing adequacy. Each predictor variable was a continuous measure of percentage-point change that was re-scaled to indicate a 10-percetange-point change, which has a more practical interpretation. We hypothesized a weak correlation since the Gap Analysis intervention targets do not include specific items about nurse staffing adequacy but instead measure evidence-based managerial decision-making that would include staffing and other organizational resources. Hospital-level percentages of nurses with high burnout, intent to leave, poor/fair quality of care, and unfavorable patient safety grades were primary outcomes. Beta coefficients, CIs and *P* values are reported for both partly and fully adjusted ordinary least squares linear regression models of the effects of the hospital-level percentage-point change in predictors on the hospital-level percentage-point change in outcomes. Our model is a change-on-change model at the hospital level. Hospital characteristics that are invariant over time (eg, teaching status) or functionally so (eg, numbers of beds) are not included as between-hospital controls, as they are not relevant to (and disappear arithmetically from) the changes over time that we are studying within hospitals. Partly adjusted models estimate effects of each predictor variable separately, while the fully adjusted model estimates the effects simultaneously. All models control for hospital country, that is, fixed effects for time-invariant country characteristics. Observed changes in the primary outcomes (ie, high burnout, intent to leave, poor/fair quality of care, and unfavorable patient safety grades) are reported among hospitals characterized as having low ($\leq 0\%$), medium (1%–25%), or high ($> 25\%$) intervention target completion. Analyses were conducted in STATA Version 18.0. The threshold for statistical significance was established a priori at $P < 0.05$ for a 2-sided test.

RESULTS

Extent of Intervention Implementation

Most of the 56 Magnet4Europe hospitals improved their percentage of fully implemented intervention targets (Gap Analysis items) during the intervention period (Fig. 2). Five hospitals had no change and 7 had reductions in percentage of Gap Analysis items implemented, which may be indicative of intervention hospitals learning more about the definition of items from their US twinning partners and reducing their score at follow-up as a result. Among the hospitals with improvements over time, changes ranged from 1% to 48% more intervention targets fully implemented. As shown in Figure 3, by the end of the formal 2-year intervention period, the average hospital had fully implemented 50% of intervention targets (with a range of 18%–90%).

Extent of Improved Staffing Adequacy

Thirty-four intervention hospitals experienced improvements over the intervention period in percentage of nurses reporting staffing adequacy; reports of adequate nurse staffing got worse in approximately one-third (n = 22) of intervention hospitals (Fig. 4). We found no statistically significant differences between countries for our predictors. The results of ANOVA tests with Bonferroni adjustments comparing (1) change in intervention targets fully implemented and country and (2) change in perceptions of nurse staffing adequacy and country were $P = 0.1929$ and $P = 0.2836$, respectively. Pearson correlation of hospitals' percentage-point change in intervention targets fully implemented and percentage-point change in nurses' perceptions of staffing adequacy was weak and not statistically significant ($r = 0.08$, $P = 0.55$).

In partly adjusted models, a positive change in percentage of intervention targets fully implemented was associated with statistically significant reductions in measures of poor nurse well-being, unfavorable quality of care, and unfavorable patient safety (Table 1). Each 10-percentage-point increase in the percentage of intervention targets fully implemented was associated with a 2.12 percentage-point reduction in the percent of nurses

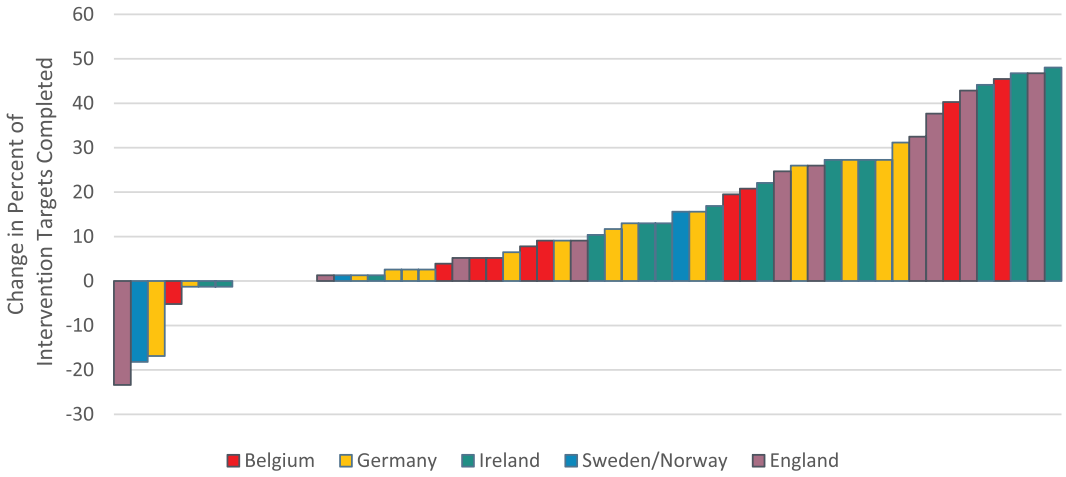

FIGURE 2. Hospital variation in the percentage-point change in Magnet4Europe intervention targets (Gap Analysis items) fully implemented during the intervention period. Notes. Hospitals located in Sweden and Norway are combined to protect anonymity of hospitals because of smaller total number of participating hospitals.

with high burnout (β −2.12; 95% CI: −4.05, −0.19, $P < 0.05$) and 2.66 percentage-point reduction in the percent of nurses who intended to leave their hospital (β −2.66; 95% CI: −4.74, −0.58, $P < 0.05$). Increases in percentage of intervention targets fully implemented was significantly associated with reductions in unfavorable sleep quality, not recommending hospital as a good place to work, not feeling involved in the team, low engagement in work, poor/fair quality of care, and unfavorable culture of patient safety scores.

A positive change in the percentage point of nurses reporting nurse staffing adequacy was associated with statistically significant reductions in measures of unfavorable nurse well-being, poor control over workload, unfavorable quality of care, and unfavorable patient safety. Each 10-percentage-point increase in the percentage of nurses reporting nurse staffing adequacy was associated with a 5 percentage-point reduction in the percent of nurses with high burnout (β −4.98; 95% CI: −7.62, −2.34, $P < 0.001$), and a 3.57 percentage-point reduction in the percent of nurses who intend to leave their hospital (β −3.57; 95% CI: −6.69, −0.44, $P < 0.05$). Nurses in hospitals that improved nurse staffing adequacy over the intervention period were less likely to report having their work frequently interrupted/delayed by operational failures, and often/always having to work very fast or having to do many tasks simultaneously. Improvements in staffing adequacy were significantly associated with reductions in unfavorable ratings in quality of care and patient safety. Each 10-percentage-point increase in the percentage of nurses reporting nurse staffing adequacy was associated with a 2.74 percentage-point reduction in nurses missing care (β −2.74; 95% CI: −5.30, −0.18, $P < 0.05$), a 2.73 percentage-point reduction in poor/fair quality of care ratings (β −2.73; 95% CI: −4.97, −0.49, $P < 0.05$), and 5.55 percentage-point reduction in unfavorable patient safety grades (β −5.55; 95% CI: −8.44, −2.65, $P < 0.001$). Beta coefficients can be interpreted in the context of the baseline measures presented in eTable 1, Supplemental Digital Content 1, http://links.lww.com/MLR/D109.

The key observation from the fully adjusted model (Table 1) when comparing coefficients for the same predictor variables with (fully adjusted) and without (partly adjusted) the other controlled, is that the estimated effects vary modestly—as expected given their low correlation with each other. Controlling for the percentage-point change in nurse staffing adequacy, improvements in intervention targets fully implemented remain statistically significantly associated with reductions in poor sleep quality, intentions to leave, poor/fair quality of care, and unfavorable culture of patient safety scores. All models control for differences across countries, and we find little evidence that changes over time in measures varied by country.

Table 2 shows observed changes in primary outcomes among hospitals characterized by low (≤0%), medium (1%–25%), or high (>25%) improvements in the full implementation of intervention targets. Among the 12 intervention hospitals characterized as having Low intervention target improvements, we observed small increases in nurse burnout, intention to leave, and unfavorable quality of care. Among the 28 hospitals characterized by medium improvements in the intervention targets, we observed modest reductions in poor outcomes. Among the 16 intervention hospitals with high improvements in full implementation of the intervention targets, we observed 6.3 percentage-point reductions in nurse burnout, 7.6 percentage-point reductions in intent to leave, 6.4 percentage-point reductions in unfavorable care quality, and 3.7 percentage-point reduction in unfavorable patient safety.

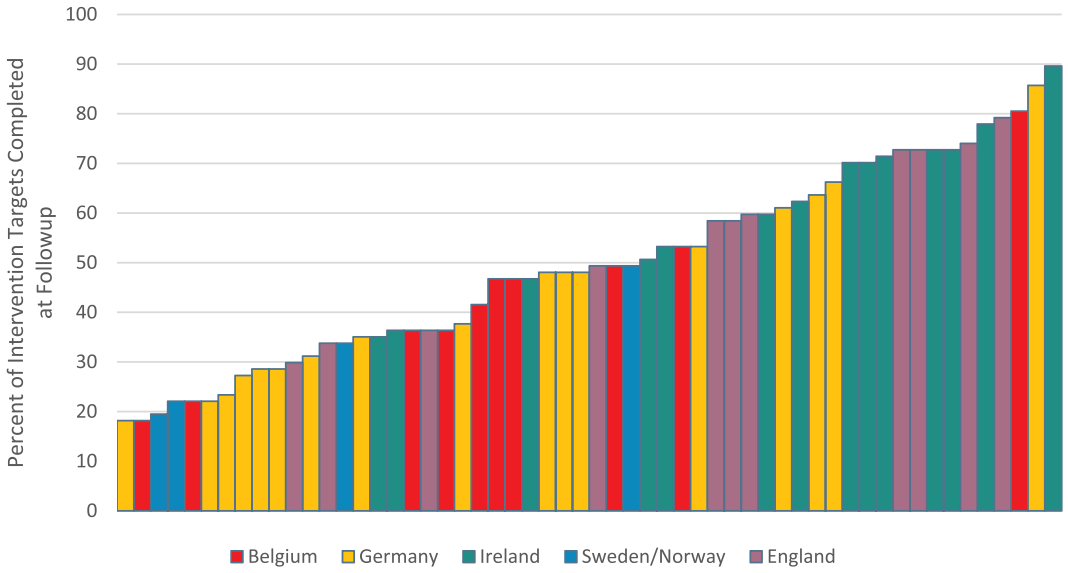

FIGURE 3. Hospital variation in the percentage of Magnet4Europe intervention targets (Gap Analysis items) fully implemented at follow-up. Notes. Hospitals located in Sweden and Norway are combined to protect anonymity of hospitals because of smaller total number of participating hospitals.

DISCUSSION

We report the findings here of a first-of-its-kind prospective evaluation of a large-scale international intervention to improve clinician well-being and patient safety by changing the organization and culture of hospital work environments. To our knowledge, this is the first study to demonstrate that a definitive organizational intervention in hospitals designed to improve clinician work environments and retention and previously tested in cross-sectional research has the same positive results when implemented in a large group of volunteer hospitals. This is new evidence that the Magnet model is not simply a recognition of high performing hospitals but adds to an expanding research literature that is beginning to build a case that the Magnet model helps shape positive hospital work environments.

Our findings also provide insight into whether it is feasible to scale the Magnet model outside the United States Only Saudi Arabia outside the United States has a critical mass of 9 Magnet hospitals. Otherwise, there are 14 Magnet hospitals in 11 countries, and over time many international Magnets have failed to be sustained. Because of the early 1980s study[12] identifying 41 Magnet hospitals on the basis of their success in retaining nurses despite high vacancy rates in other hospitals, the US Magnet hospital movement began at scale. Magnet4Europe attempted to replicate the US Magnet experience beginning at scale by supporting over 60 European hospitals to begin the Magnet journey together. In addition, we bolstered the aspiring European hospitals by 1:1 twinning with US Magnet hospitals, a Europe-based network of intervention hospitals, and learning collaboratives. With this level of support, the average European hospital completed half of the intervention targets within **a** 2-year implementation period, and a few hospitals attained almost all intervention targets. **I**t takes an average of 4.25 years to attain Magnet credentialing for US hospitals and 10 years for hospitals outside the United States.[30] Reductions in burnout and intentions to leave and in unfavorable care quality and safety were not only statistically significant but clinically meaningful when hospitals had achieved over 25% of the intended targets suggesting with more time, even greater improvements in outcomes can be achieved. Thus, hospital leaders should derive increased confidence that concerted actions to improve hospital work environments and staffing adequacy can result in improved retention of clinicians and better care quality and safety.[30]

Post-hoc analysis of model coefficients demonstrate sizable, expected reductions in poor outcomes under the hypothetical scenario that all intervention hospitals fully implemented at least 75% of the intervention targets and at least 50% of nurses reported staffing adequacy. Expected reductions under this scenario are: 17.8 percentage-point reduction in nurses with high burnout, 14.6 percentage-point reduction in intentions to leave, 11.9 percentage-point reduction in poor/fair quality of care, and 17.5 percentage-point reduction in unfavorable patient safety grades.

In 2002, the American Hospital Association (AHA) published a major report entitled *In Our Hands: How Hospitals Can Build a Thriving Workforce.*[31] The report was a call to action to hospital leaders to fix the root causes of clinician dissatisfaction by creating fulfilling work environments, fostering meaningful work, and improving capabilities of front-line managers to retain sat-

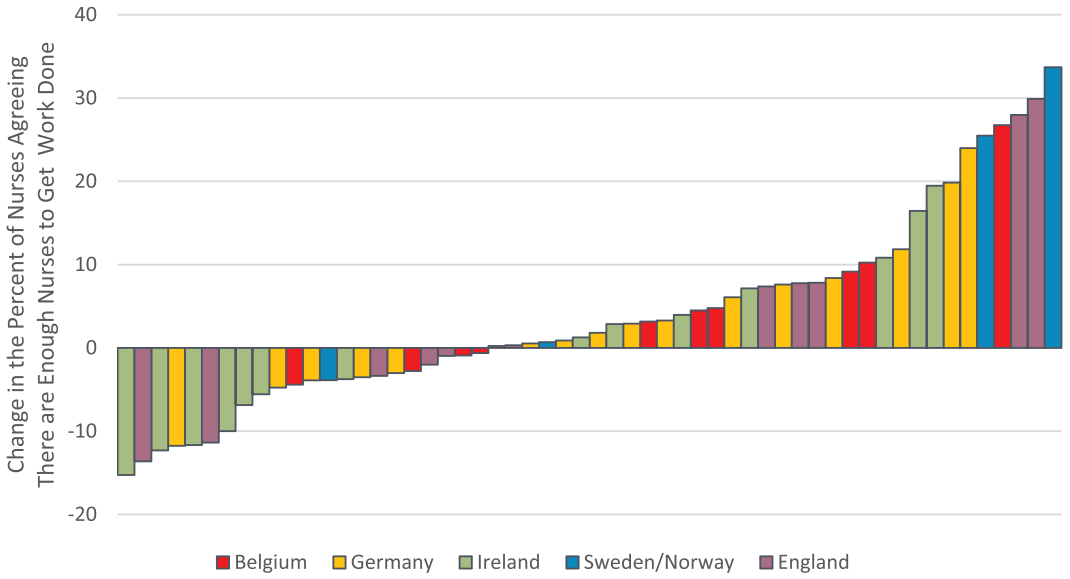

FIGURE 4. Hospital variation in the percentage-point change in nurses' reports of staffing adequacy during the intervention period. Notes. Hospitals located in Sweden and Norway are combined to protect anonymity of hospitals because of smaller total number of participating hospitals.

isfied clinicians. Magnet4Europe supports the basis of that AHA report—that it is within the power of hospital leaders to improve clinician satisfaction and retention. However, instead of acting to improve work environments, hospital leaders continue to blame clinician shortages on external forces. Multiple studies[2,4,14] document substantial lack of confidence among nurses and physicians in hospital management to listen and respond to clinicians' concerns about poor patient care. Magnet4Europe offers affirmation that improved hospital work environments are feasible to achieve regardless of external factors.

Limitations

Pandemic-related circumstances required an adaptation of the original research protocol from an experimental design with wait-listed randomization to a quasi-experimental prospective evaluation using each hospital as its own control.[20] Thus, we cannot rule out secular improvements in clinician well-being over the period studied as the number of COVID-19 cases declined as an explanation for improved outcomes. However, we document that improvements were directly associated with the extent of intervention implementation and not all participating hospitals experienced improved outcomes bolstering the case that the intervention was driving improvements in outcomes.

CONCLUSIONS

The Magnet4Europe intervention was associated with significant improvements in nurse well-being and care quality by employing an evidence-based intervention, the Magnet model, successful in the United States but not yet experiencing significant uptake in Europe. Results show hospital workplace organization and culture change are possible, and when implemented, are associated with improvements in clinician and patient well-being. It is within the power of hospital leadership to improve clinician retention, which is key to addressing global clinician shortages and patient safety concerns.

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TABLE 1. Partly Adjusted and Fully Adjusted Models Showing the Effects of a 10-Percentage-Point Change in Intervention Targets Fully Implemented and Nurse Staffing Adequacy on Percentage-Point Changes in Nurse Outcomes, Control Over Work, and Patient Care Quality and Safety

	β (95% CI)			
	Partly adjusted models of…		Fully adjusted model of…	
	10%-point change in intervention targets fully implemented	10%-point change in nurse staffing adequacy	10%-point change in intervention targets fully implemented	10%-point change in nurse staffing adequacy
Nurse Well-being				
% High burnout	−2.12 (−4.05, −0.19)*	−4.98 (−7.62, −2.34)***	−1.59 (−3.36, 0.18)	−4.57 (−7.20, −1.94)**
% Unfavorable overall health	−0.27 (−2.21, 1.68)	−2.79 (−5.56, −0.01)*	0.06 (−1.86, 1.98)	−2.80 (−5.65, 0.05)
% Unfavorable sleep quality	−2.05 (−3.80, −0.30)*	−2.79 (0.54, −0.17)*	−1.78 (−3.51, −0.04)*	−2.33 (−4.90, 0.25)
% Poor work-life balance	−1.58 (−3.64, 0.48)	−3.70 (−6.65, −0.75)*	−1.18 (−3.19, 0.83)	−3.39 (−6.38, −0.41)*
% Intent to leave	−2.66 (−4.74, −0.58)*	−3.57 (−6.69, −0.44)*	−2.31 (−4.37, −0.26)*	−2.97(−6.02, 0.08)
% Would not recommend hospital as place to work	−1.85 (−3.54, −0.16)*	−3.29 (−5.74, −0.84)**	−1.51 (−3.15, 0.13)	−2.90 (−5.33, −0.47)*
% Do not feel involved in the hospital	−1.06 (−2.60, 0.48)	−2.25 (−4.48, −0.01)*	−0.82 (−2.35, 0.71)	−2.04 (−4.30, 0.23)
% Do not feel involved in the team	−1.96 (−3.84, −0.07)*	−1.81 (−4.68, 1.06)	−1.80 (−3.72, 0.12)	−1.35 (−4.19, 1.50)
% Low engagement in work	−2.12 (−4.10, −0.13)*	−3.36 (−6.28, −0.44)*	−1.78 (−3.73, 0.18)	−2.90 (−5.80, −0.01)*
Control over workload				
% often/always have to work very fast	−0.02 (−1.36, 1.31)	−2.18 (−4.06, −0.30)*	0.24 (−1.06, 1.54)	−2.24 (−4.17, −0.31)*
% often/always interrupted at work	−1.16 (−3.09, 0.76)	−3.27(−6.01, −0.52)*	−0.80 (−2.69, 1.08)	−3.06 (−5.85, −0.27)*
% often/always have to do many tasks simultaneously	−0.95 (−2.57, 0.67)	−3.43 (−5.66, −1.20)**	−0.56 (−2.10, 0.97)	−3.29 (−5.56, −1.01)**
% frequently interrupted/ delayed by operational failures	−0.49 (−2.87, 1.89)	−3.85 (−7.21, −0.49)*	−0.04 (−2.37, 2.29)	−3.84 (−7.29, −0.39)*
% team does not work efficiently together	−1.66 (−3.70, 0.37)	−3.78 (−6.69, −0.87)*	−1.26 (−3.24, 0.72)	−3.46 (−6.40, −0.52)*
Quality of care and patient safety				
% Missed care	0.89 (−0.90, 2.67)	−2.74 (−5.30, −0.18)*	1.24 (−0.49, 2.98)	−3.06 (−5.63, −0.48)*
% Unfavorable quality of care, poor/fair	−1.84 (−3.35, −0.33)*	−2.73 (−4.97, −0.49)*	−1.57 (−3.05, −0.08)*	−2.33 (−4.53, −0.13)*
% Unfavorable patient safety grade	−1.55 (−3.73, 0.63)	−5.55 (−8.44, −2.65)***	−0.93 (−2.92, 1.06)	−5.31 (−8.26, −2.36)***
Unfavorable culture of patient safety, summary score	−1.97 (−3.03, −0.91)***	−3.07 (−4.62, −1.52)***	−1.66 (−2.62, −0.70)**	−2.64 (−4.07, −1.22)***

Note. Approvals for the use of the MBI instrument were obtained from Mind Garden, Inc. The partly adjusted models separately estimate the effects of a 10-percentage-point change in interventions targets fully implemented and a 10-percentage point change in nurse staffing adequacy on changes in the outcomes, while controlling for differences across countries. The fully adjusted model simultaneously estimates the effects of a 10-percentage-point change in intervention targets fully implemented and a 10-percentage-point change in nurse staffing adequacy on changes in the outcomes, while controlling for differences across countries.

***$P < .001$,

**$P < .01$,

*$P < .05$

TABLE 2. Observed Changes in Outcomes Among Study Hospitals With Low, Medium, and High Improvements in Intervention Target Completion

	Improvement in intervention target completion		
	Low	**Medium**	**High**
% high burnout	0.1%	−1.8%	−6.3%
% intent to leave	2.0%	0.4%	−7.6%
% unfavorable quality of care	0.6%	−1.1%	−6.4%
% unfavorable patient safety grade	−1.3%	−2.2%	−3.7%
No. hospitals	12	28	16

Note. Categories of improvement in intervention target completion are defined hospitals' percentage-point improvement in the completion of intervention targets. Hospitals with less than 0% target completion (low); 1–25% target completion (medium); more than 25% target completion (high).

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