



The Effectiveness of Interventions to Increase Employment in Education and Healthcare: A Systematic Literature Review

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Abstract

Both the healthcare and education sector suffer from considerable staff shortages. In the healthcare sector, shortages are particularly prominent for nurses, while the education sector experiences significant teacher shortages. In this systematic literature review, we examine the effectiveness of interventions and policies to reduce staff shortages in healthcare and education in high-income countries. We focus our analysis on studies that apply research designs that allow for causal inference to inform policymakers about the effectiveness of interventions. In total, we include 85 studies that meet our inclusion criteria. Out of these studies, 71 studies focus on teachers and 14 on nurses, and 72 of the retrieved studies were conducted in the US. The majority of studies examine the impact of financial incentives and a large share of these studies report positive effects on teacher employment. Moreover, different types of interventions that invest in workers' human capital show predominantly positive effects on employment. Interventions that equip nurses with skills to better cope with the stressors of their profession seem to be particularly effective. The same holds for policies that increase the scope of practice for nurses. Finally, effective school leaders are better capable of retaining (high-quality) teachers.

Keywords Labor shortage · Teachers · Nurses

JEL Classification I10 · I20 · J22

1 Introduction

Healthcare and education sectors around the world have been experiencing considerable staff shortages (e.g., OECD, 2016; UNESCO, 2016; WHO, 2022b). The World Health Organization (WHO, 2022b) forecasts a global need of an additional 9 million nurses and midwives by 2030 to be able to reach the United Nations' (UN) goal

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of “ensuring healthy lives and promoting well-being for all at all ages” (UN, 2021a, 2021b). Similarly, according to the UNESCO Institute for Statistics, there is a need to recruit 69 million teachers worldwide by 2030 in order to achieve broad universal coverage of primary and secondary educational needs (UNESCO Institute for Statistics, 2016).

Shortages in healthcare and education sectors are also closely connected to the United Nations’ Sustainable Development Goal (SDG) 8, which aims to achieve “sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all” (UN, 2021a, 2021b). First, long-run economic growth is affected by human capital (Barro, 2001) and health (Cervellati & Sunde, 2005) where the provision of adequate education and healthcare is threatened by shortages in key occupations in these sectors. In the healthcare sector, shortages are highest for nurses and midwives, making up for more than 50 percent of total staff shortages in healthcare (WHO, 2021, 2022a, 2022b). Nurse shortages have detrimental effects on quality of care and societal health outcomes, e.g., exacerbating patient mortality (Aiken et al., 2002), and increasing 30-day hospital readmission rates (Friedrich & Hackmann, 2021). Relatedly, teachers are one of the most important inputs for human capital (Hanushek, 2011). Failing to deliver high-quality education over time could result in gaps in relevant knowledge and skills crucial for social and economic development (European Commission/EACEA/Eurydice, 2019; Santiago, 2002; UNESCO, 2016)). Second, a common reason for nurses and teachers to abandon their occupations are suboptimal working conditions such as low wages and high workloads (e.g., Chan et al., 2013; Gjefsen, 2020). Improving the working conditions in both sectors could increase employment and promote decent work for healthcare and education workers, directly supporting the achievement of SDG 8.

The shortage for healthcare workers can be partly attributed to demographic trends, such as declining birth rates, an aging society, and increasing retirement rates. Simultaneously, the demand for healthcare services is rising due to the aging population, a trend further exacerbated by the overall increase in life expectancy (OECD/European Union, 2022). Additionally, many nurses leave the profession early in their careers or before reaching retirement age due to high levels of workload, stress, fatigue, and low wages (Chan et al., 2013; Gjefsen, 2020; WHO, 2022a, 2022b). These suboptimal conditions are linked to decreasing job satisfaction (Chan et al., 2013; El-Jardali et al., 2009), increasing sickness absence rates (Rauhala et al., 2007), and a growing inclination to leave their employer or the nursing profession entirely (e.g., Barron & West, 2005; El-Jardali et al., 2009; Lu et al., 2012).

The education sector faces an uneven distribution of teachers across subjects (mainly STEM) and regions, causing shortages and oversupply to often co-exist in the same countries (European Commission/EACEA/Eurydice, 2019). Furthermore, high dropout rates out of initial teacher education (European Commission/EACEA/Eurydice, 2019) further exacerbate an ageing teacher population, with only 7 percent of teachers being under 30 years old and 36 percent of teachers being 50 or older (Katsarova, 2020). Regional shortages can occur due to factors such as economic opportunities, cultural context, the school environment and student population (European Commission/EACEA/Eurydice, 2019). These aspects are reflected in a relatively high level of teacher shortages in disadvantaged, high-poverty schools

in rural and urban areas, typically employing a larger share of lower-quality teachers (Hanushek et al., 2004; Ingersoll, 2004; Monk, 2007; Sutchter et al., 2019). The difficulty of low-performing, high-poverty schools to compete for the limited number of high-quality teachers is often exacerbated by their inability to meet salary standards, benefits, and resources that are offered by more upscale schools (Ingersoll, 2004).

The wide array of determinants for nurse and teacher shortages calls for a variety of interventions to reduce staff shortages targeting different mechanisms and levels. In this paper, we conduct a systematic literature review to assess the effectiveness of interventions to reduce staff shortages in healthcare and education in high-income countries. Importantly, we focus our analysis on studies that apply research designs that allow for causal inference to inform policymakers about the effectiveness of interventions.

We examine shortages in healthcare and education sectors jointly, as both sectors are crucial for society and have similar causes of shortages and working conditions, such as relatively low salaries (e.g., Chan et al., 2013; Gjefsen, 2020; Ingersoll, 2004; Lephalala et al., 2008; Monk, 2007) and demanding workloads (e.g., Chan et al., 2013; Gjefsen, 2020; Harris, 1989; Hipwell et al., 1989; Kirkcaldy & Martin, 2000). Both sectors also employ a relatively high share of female workers (Katsarova, 2020; OECD, 2021; WHO, 2021, 2022a, 2022b), contributing to shortages due to higher rates of parental leave (Friedrich & Hackmann, 2021) and part-time work (Booth & van Ours, 2013). Given these similarities, effective interventions in one sector may be insightful for the other sector. While existing systematic reviews typically address nurse or teacher shortages separately, we compare interventions for both to explore opportunities for cross-sector application and novel shortage mitigation strategies.

Furthermore, other reviews often focus on predictors of turnover or retention (e.g., Chan et al., 2013; Falatah, 2021; Wu et al., 2015). In comparison, this systematic review contributes by focusing on the assessment of potential solutions to increase employment in these shortage occupations rather than exploring predictors for the shortages. While the objective of mitigating shortages may require an understanding of the problem itself, from a policy perspective it is crucial to move towards the search of effective interventions. Variables that significantly predict turnover or retention may not cause turnover and retention. Policymakers may be then tempted to affect the predictor yet be ineffective as correlation is confused with causation. Additionally, predictors may not be malleable. For example, an ageing population may predict greater staff shortages, however, this does not immediately provide a solution to the issue of greater shortages.

Moreover, our review covers various subgroups within the nurse and teacher workforce, unlike other reviews that focus on specific populations such as geriatric nurses or special education teachers (e.g., Billingsley, 2004; Billingsley & Bettini, 2019; Brook et al., 2019; Chenoweth et al., 2010; Lartey et al., 2014). By extending the analysis beyond a single study population, we can better assess overall interventions effectiveness across subgroups and understand their external validity for the overall nurse and teacher workforce. In terms of breadth, Park and Yu's (2019) review is closely related to ours, however, their study focuses on nurses only and they do not restrict their analysis to causal impact studies. One distinct strength of

this systematic review is its strict focus on (quasi-)experimental research designs. Our analysis excludes correlational studies and covers only those claiming causal effects of the introduced interventions. This allows us to compare the interventions' effectiveness. To our knowledge, only See et al. (2020) restrict their systematic review to quasi-experimental studies. Yet, their scope is limited to interventions for teacher shortages in hard-to-staff areas. Hence, we extend this review by considering the overall teacher labor market and adding nurse shortages to the analysis.

This paper is structured as follows: Sect. 2 outlines the methodology by describing the systematic literature search and selection processes as well as the approach to analysis. Section 3 provides synthesized findings from the analyzed studies, distinguishing interventions into several groups related to financial incentives, human capital investments, organizational features, school accountability and other interventions. In Sect. 4, results as well as their comparability and generalizability are discussed, limitations identified and implications for future research and policy highlighted.

2 Methodology

2.1 Inclusion and Exclusion Criteria

Before we performed our systematic literature search, we set inclusion and exclusion criteria, i.e., a set of conditions for the records we retrieved from the searches to be eligible for inclusion in the analysis. We restricted our analysis to high-income countries according to the categorization of the World Bank (2022).¹ Further, we limit our analysis to studies measuring the impact of at least one intervention or policy addressing, or contributing to, nurse or teacher shortages. Interventions could be either targeted at decreasing the outflow or increasing the inflow of staff, or at work hours. Outcome measures for turnover and retention could either be measured as actual behavior or as reported intentions. We excluded papers that examined teacher or nurse absenteeism. Within the education sector, we limit our literature selection to primary and secondary education. Further, we exclude studies measuring the impact of interventions on the quality of healthcare and education, measured by commonly used proxies such as e.g., hospital readmission rates or student achievement.

With respect to the type of methodology, we exclude qualitative and non-causal quantitative studies and exclusively include quantitative studies that are suitable for causal inference according to Van Klaveren and De Wolf (2013). These include (clustered) randomized controlled trials (RCTs) or quasi-experimental techniques, including difference-in-differences, instrumental variable(s), regression discontinuity designs, propensity score matching, and fixed-effects regressions.

¹ An overview of high-income countries according to the WorldBank can be found at: <https://data.worldbank.org/country/XD>

2.2 Literature Search

We conducted two systematic literature searches in January and May 2022. Initially, we performed a search in Web of Science (Core Collection) with search terms (and terms related to) “teachers” or “nurses” paired with “shortage”, “turnover”, “mobility”, “attrition”, “transition”, “retention”, “productivity” in addition to terms entailing research designs for causal inference (e.g., “experiment*”). We restricted the search terms to appear only in the title, abstract and keywords of papers. After completion of the screening process, we realized that our search did not cover some of the studies that were considered as seminal papers by experts in the field. Therefore, we considered options to retrieve a more complete set of causal studies. We ran a second search, whilst continuing to include the relevant publications from our first attempt. For the second search strategy, we sought support from a medical information specialist. Together, we conducted additional systematic searches in an expanded set of bibliographic databases ERIC (Ebsco), CINAHL (Ebsco), and Web of Science (Core Collection).² The following search terms were used (including synonyms and closely related words) as index terms or free-text words: “teachers”, “nurses”, “nursing”, “shortage”, “turnover”, “retention”, “causal effect”. The full set of search terms for all databases can be found in Appendix 1.

2.3 Literature Selection

Figure 1 provides a summarized overview of the literature selection processes following the initial and updated literature searches. Subsequently, the results of both selection processes are separately described in more detail.

By using our initially determined search terms in the database, we retrieved 8202 initial hits from Web of Science. After applying database filters for journal articles as document type, publication dates between 2010 and 2022, English language, and high-income countries, we obtained 4892 abstracts to screen. We screened abstracts in a reiterative manner, where one researcher pre-screened the database retrieval and marked studies that appear to fit the selection criteria.³ After excluding irrelevant papers based on the respective abstracts, we were left with a total of 195 records to be double-checked. Three researchers then went through this narrowed selection and indicated papers’ suitability by checking the respective full-text versions for the study designs and further in- and exclusion criteria. Each paper was checked independently by at least two researchers. To reach consensus, we together reviewed, compared, and discussed the inclusion and exclusion of studies for which decisions

² We choose to perform an additional search in ERIC as it is the largest index of education journals. Likewise, CINAHL indexes the nursing and health related literature.

³ To ensure reliability that the pre-selected papers meet the inclusion criteria, we picked a random sample of 100 studies from the total set of excluded studies which were then checked by two additional reviewers. For additional reviewer 1 and 2 there was a 99 and 98 percent overlap in ratings with the reviewer that pre-screened the abstracts, respectively. The conflicting abstracts – rated as “maybe” instead of “reject” – were discussed and fully rejected after group discussion based on the abstract content. As the overlap is close to complete, and the checking process did not lead to the inclusion of additional studies, we concluded that our procedure is reliable.

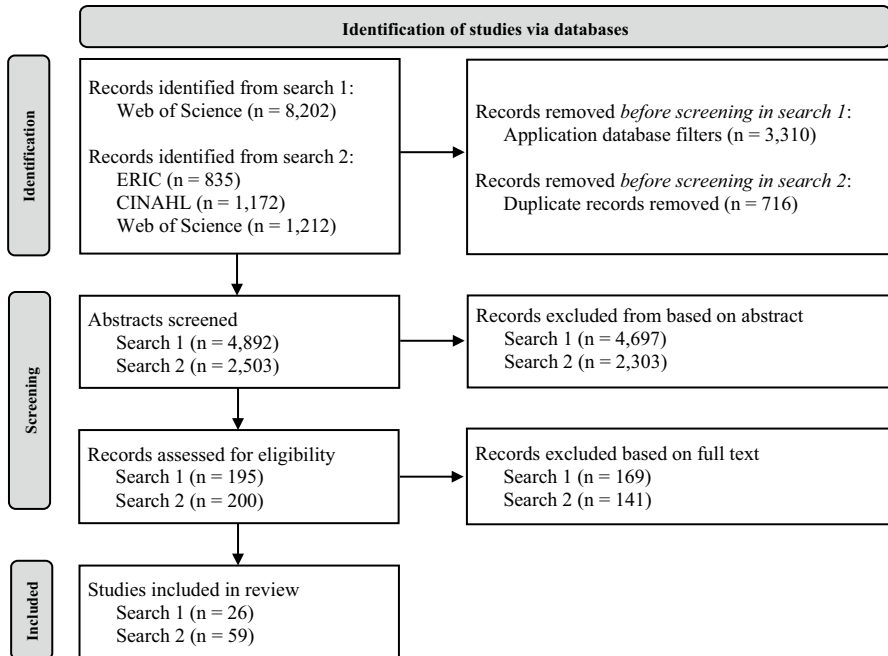


Fig. 1 Selection process following search strategy 1 (January 2022) and search strategy 2 (May 2022)

between two researchers were inconclusive. After this stage of screening, we were left with 26 articles for analysis from search 1.

Our second literature search generated a total of 3219 references: 835 in ERIC, 1172 in CINAHL and 1212 in Web of Science. After removing duplicates that were retrieved from more than one database, a total of 2503 records remained. The selection process was identical to the first selection process. First, one researcher pre-screened all abstracts. Next, full-texts of each of the pre-selected 200 articles were checked independently by three researchers which led to an ultimate selection of 59 papers after correcting for duplication from the first search.⁴ Overall, the first and second search led to the inclusion and analysis of 85 papers (Table 1).

2.4 Method of Analysis

To analyze the retrieved studies, we extracted study characteristics and developed a coding scheme. Besides metadata such as publication title, date, and source, we extracted relevant information regarding the sector and subsector of study, the country and region, a thorough description of the intervention and its level of implementation (e.g., sector-level, district-level, institution-level). Further, we listed mechanisms that

⁴ In addition to removing papers that did not meet our inclusion criteria, we removed 5 working papers and 1 policy brief. 7 papers were inaccessible.

are targeted by the intervention, outcome measures, data sources and sample characteristics as well as study results and limitations. Finally, we coded whether the estimated *overall* effect for the total sample either increased (+), had no effect on (0), or decreased (–) teacher or nurse employment. In addition, we find that some papers report overall null effects, yet show that for certain subgroups – e.g. teachers with certain characteristics – the treatment did have a positive or negative effect on employment. These are indicated with dash (0/+) or (0/–) in Tables 2, 3, 4 and 5, respectively. Finally, some papers report multi-directional effects for different groups without a clear overall effect. These interventions are marked as having no effect (0) on employment.

3 Results

Overall, we retrieved a total of 85 studies out of which 71 focused on teachers and 14 on nurses (Table 1). Remarkably, 72 of the retrieved studies were conducted in the US, four in Norway, two each in Chile and Korea, and one each in Denmark, France, the Netherlands, Sweden and Uruguay. We grouped the studied

Table 1 Overview of all retrieved studies' characteristics

	Education	Healthcare	Total
N	71 (83.5%)	14 (16.5%)	85 (100.0%)
<i>Country</i>			
Chile	2 (2.8%)	0 (0.0%)	2 (2.4%)
Denmark	0 (0.0%)	1 (7.1%)	1 (1.2%)
France	0 (0.0%)	1 (7.1%)	1 (1.2%)
Korea	0 (0.0%)	2 (14.3%)	2 (2.4%)
Netherlands	1 (1.4%)	0 (0.0%)	1 (1.2%)
Norway	3 (4.2%)	1 (7.1%)	4 (4.7%)
Sweden	1 (1.4%)	0 (0.0%)	1 (1.2%)
US	63 (88.7%)	9 (64.3%)	72 (84.7%)
Uruguay	1 (1.4%)	0 (0.0%)	1 (1.2%)
<i>Main intervention category</i>			
Financial incentives	29 (40.8%)	1 (7.1%)	30 (35.3%)
Human capital investments	10 (14.1%)	5 (35.7%)	15 (17.6%)
Organizational features	7 (9.9%)	4 (28.6%)	11 (12.9%)
Accountability	18 (25.4%)	0 (0.0%)	18 (21.2%)
Other	7 (9.9%)	4 (28.6%)	11 (12.9%)
<i>Methodology</i>			
Difference-in-differences	25 (35.2%)	5 (35.7%)	30 (35.3%)
Fixed effects	9 (12.7%)	3 (21.4%)	12 (14.1%)
Instrumental variables	3 (4.2%)	1 (7.1%)	4 (4.7%)
Propensity score matching	3 (4.2%)	0 (0.0%)	3 (3.5%)
Randomized control trial	13 (18.3%)	5 (35.7%)	18 (21.2%)
Regression discontinuity	18 (25.4%)	0 (0.0%)	18 (21.2%)

interventions into the following main categories: Financial incentives, human capital investments, organizational features, school accountability and its consequences, and other interventions. Among the 85 retrieved papers, 18 describe outcomes of RCTs. The remaining studies use the following quasi-experimental methodologies: difference-in-differences, regression discontinuities, fixed-effect models, instrumental variables, and propensity score matching.

Many of the interventions reviewed aim to tackle well-documented causes of teacher and nurse shortages highlighted in the literature, such as low wages, increasing retirement rates, high dropout rates from study programs and early careers, and heavy workloads. For instance, a significant portion of studies focuses on financial incentives aimed at mitigating the issue of low wages. Some of these studies specifically examine incentives designed to attract teachers to hard-to-staff schools or subjects. Additionally, several studies investigate whether financial incentives can encourage teachers to delay retirement, thereby addressing the challenge of an aging workforce. Furthermore, several studies explore the impact of loan forgiveness programs, which can reduce high dropout rates from initial teacher education programs and incentivize students to pursue teaching careers. The review also encompasses research on induction programs, which are designed to lower attrition rates among early-career teachers. Finally, other studies analyse the effect of workload on teachers, examining changes in curriculum and teaching requirements. Importantly, the majority of studies focus on increasing the labor supply through the extensive margin, i.e., by hiring more teachers. Only one study focuses on the intensive margin, i.e., by examining how an intervention increases the number of hours worked.

3.1 Financial Incentives

As listed in Table 2, a total of 30 studies – 29 in the context of education and 24 situated in the US – describe causal effects of financial incentives on entry and exit decisions of teachers and nurses. Payments that result from incentive schemes can be conditioned on the worker's choice or action – for example being employed at a hard-to-staff school or meeting some performance target – or can be independent. Moreover, payments from an incentive scheme can be a one-time occurrence in the form of a bonus or can occur continuously as a definite wage or pension increase. We classify the different financial incentives along the aforementioned dimensions: According to the criteria on which they depend and whether the potential wealth increase is a short-lived occurrence or continuous.

3.1.1 Wage increase conditioned on working conditions

Four studies examine the impact of a wage increase conditional on teachers' willingness to work in a hard-to-staff school. By increasing wages, it is hypothesized that outside job options become less attractive and more teachers are willing to remain teaching or are attracted to the profession. All studies show results in the hypothesized direction: As wages increase, entry rates increase and exit rates decrease. Cabrera and Webbink (2020) show that more experienced workers sort into

Table 2 Overview of studies within the category “Financial incentives”

Author(s) (year)	Intervention group	Treated sample	Level	Design	Outcome
Bueno and Sass (2019)	Wage increase based on working conditions	Understaffed subjects, secondary schools in US	State	DiD	Increase in retention (+)
Cabrera and Webbink (2020)		Disadvantaged, primary schools in Uruguay	Country	RD	Increase in retention and/or entry (+)
Falch (2011)		Understaffed primary and secondary schools in Norway	County	DiD	Increase in retention (+)
Falch (2017)		Understaffed primary and secondary schools in Norway	County	DiD	Increase in entry (+)
Askildsen et al. (2003)	Unconditional wage increase and frontloading	Half of hospitals in Norway	Country	IV	Hours worked (+)
Cook et al. (2021)		Primary and secondary schools in US	District	RD	Decrease in entry (-)
Han (2020)		Primary and secondary schools in US	District	IV	No effect on retention (0/±)
Hendricks (2014)		Primary and secondary schools in US	State	FE	Increase in retention (+)
Tran and Buckman (2020)		Primary and secondary schools in US	District	FE	Increase in entry (+)
Brown (2013)	Greater pension conditioned on delayed retirement	Primary and secondary schools in US	State	RD	Increase in retention (+)
Kim (2023)		Primary and secondary schools in US	State	DiD	Increase in retention (+)
Koedel and Xiang (2017)		Primary and secondary schools in US	City	DiD	Increase in retention (+)
Berlinski and Ramos (2020)	Financial bonus conditioned on working conditions and teacher quality	Primary and secondary schools in Chile	Country	RD	No effect on retention (0)
Clotfelter et al. (2011)		Disadvantaged, primary and secondary schools in US	District	DiD	No effect on retention (0/+)
Cowan and Goldhaber (2018)		Disadvantaged, secondary schools in US	State	RD	Increase in retention (+)
Elacqua et al. (2022)		Primary and secondary schools in Chile	Country	RD	Increase in retention and/or entry (+)
Feng and Sass (2018)		Understaffed subjects, secondary schools in US	State	DiD	Increase in retention (+)
Glazerman et al. (2013)		Disadvantaged, primary schools in US	Country	RCT	Increase in retention (+)
Protik et al. (2015)		Disadvantaged, primary schools in US	Country	RCT	Increase in entry (+)
Springer et al. (2016)		Disadvantaged, primary and secondary schools in US	State	RD	Increase in retention (0/+)
Steele et al. (2010)		Primary and secondary schools in US	State	IV	Increase in entry (+)
Chiang et al. (2015)	Financial bonus conditioned on worker performance	Disadvantaged, primary and secondary schools in US	Country	RCT	No effect on retention and/or entry (0)
Dee et al. (2021)		Disadvantaged, primary schools in US	District	RD	No effect on retention (0/-)
Dee and Wyckoff (2015)		Primary schools in US	District	RD	No effect on retention (0/-)
Jones and Hartney (2017)		Primary and secondary schools in US	District	DiD	No effect on entry (0/+)
Shifrer et al. (2017)		Disadvantaged, primary schools in US	District	RD	No effect on retention (0/+)
Fryer (2013)	Financial bonus conditioned on group performance	Disadvantaged, primary and secondary schools in US	City	RCT	No effect on retention (0)
Goodman and Turner (2010)		Disadvantaged, primary schools in US	City	RCT	No effect on retention (0)
Jones (2013)		Primary and secondary schools in US	Country	IV	Decrease in retention (-)
Ryu and Jinnai (2021)		Primary and secondary schools in US	State	FE	Decrease in retention (-)

disadvantaged schools in Uruguay following a 26 percent salary increase. Moreover, tenure in these schools increases relative to schools without a wage increase, i.e. more teachers decide to stay. Falch (2011) and Falch (2017) also identify a labor supply increase after teachers in understaffed schools in the north of Norway receive a 10 percent wage increase. They find a 6.5 percentage point decrease in exit rates and a 5.7 percentage point increase in entry rates. Finally, Bueno and Sass (2019) find that an increase in wages of teachers in understaffed subjects decrease their likelihood of exiting.

3.1.2 Unconditional Wage Increase and Frontloading

In contrast to conditional wage increases, an unconditional wage increase reflects what would happen if wages would increase for all workers in the profession. There is no condition that must be met; one must simply be employed in teaching or nursing.

Firstly, these estimates follow from studies that use registration data in which exogenous variation in wages is identified to estimate wage effects. Askildsen et al. (2003) use administrative nursing data that track the hours worked of half of the

Norwegian registered nurses between 1993 and 1998. The authors find a labor supply elasticity of 0.2: a 1 percent increase in wages causes a 0.2 percent increase in hours worked. Hendricks (2014) uses registration data on teachers from Texas and estimates a turnover elasticity of -1.6 .

Secondly, two studies focus on the effects of unconditional wage increases that result from greater union bargaining power, implying a tradeoff between higher pay and alternative allocations of education funding where total funding is presumably fixed. Cook et al. (2021) show a decrease in hired teachers in districts where greater bargaining power led to higher salaries. In a similar vein, Han (2020) shows that districts with greater union bargaining power cause the increased dismissal of low-quality teachers and increased retention of high-quality teachers. Both cases show that overall teacher supply does not necessarily increase as wages rise. The way in which wage increases are financed is crucial in determining its overall effect on employment.

Finally, Tran and Buckman (2020) study the effects of salary frontloading where larger wage raises are provided earlier in the fixed rate salary schedule creating more competitive wages for early-career teachers. Tran and Buckman (2020) study frontloading and test its implications in a competitive teacher labor market. In particular, the authors show that more high-quality teachers sort into teaching jobs with frontloading schemes. This can be taken as (indirect) evidence that greater earnings early in the career attract teachers.

3.1.3 Greater Pension Conditioned on Delayed Retirement

Three US studies document teachers' willingness to postpone their retirement. In all studies, the effects of a policy reform for teachers are examined where delayed retirement yields financial benefits. For example, Koedel and Xiang (2017) study a pension enhancement policy that involves greater backloading of pension compensation – i.e. more pension is generated as age increases. This generates an incentive for teachers to work longer. The other two studies have a similar policy setup.

All three studies show that the increased marginal benefit of delaying retirement translates into teachers' decision to retire later. The results range from a decrease of 4 percentage points (Brown, 2013) to 10 percentage points (Kim, 2023) for workers who are in the pension eligible age category.

3.1.4 Financial Bonus Conditioned on Working Conditions and Teacher Quality

In this setting, teachers receive a financial bonus if they meet certain quality requirements *and* move to an understaffed school. We identified nine studies that document the effects of programs that are designed to attract talented teachers to disadvantaged, hard-to-staff schools.

Glazerman et al. (2013) and Protik et al. (2015) document the impact of the Talent Transfer Initiative (TTI) where teachers at the top of the quality distribution were targeted to fill vacancies at disadvantaged schools. In return, they received a one-time \$20,000 bonus if they stayed for 2 years. In comparison to the control group – business-as-usual filling of vacancies – Glazerman et al. (2013) show that

relatively more TTI candidates remain at disadvantaged schools, even after the obligatory 2-year period is over. Protik et al. (2015) show that the TTI program indeed attracts higher-quality workers with 22 percent of the potential candidates applying for transfer and 5 percent actually transferring to disadvantaged schools. Cowan and Goldhaber (2018) find qualitatively similar effects of programs that resemble the TTI program – where retention of high-quality teachers is increased at hard-to-staff, disadvantaged schools. Springer et al. (2016) and Clotfelter et al. (2011) find overall null effects with a positive effects depending on teacher characteristics.

Two studies analyze the effects of the Chilean Pedagogical Excellence Assignment program (AEP) where teachers can apply for a bonus if they meet certain quality requirements. The bonus is increased if they teach at a disadvantaged school. Overall, the Berlinski and Ramos (2020) find little effects of the program on retention decisions for all teachers to stay in the profession. Elacqua et al. (2022) do show, however, that the financial incentive to work at a disadvantaged school is effective: teachers are 6 percentage points more likely to stay. It does not attract high-quality teachers from advantaged schools, however.⁵

Finally, two studies examine the effects of loan forgiveness programs on teachers' willingness to (i) teach subjects with a teacher shortage (Feng & Sass, 2018), (ii) seek employment at disadvantaged schools (Steele et al., 2010). Both studies find corroborating evidence that loan forgiveness programs lead to enhanced entry in disadvantaged schools and decreased exits out of hard-to-staff teaching jobs.

3.1.5 Financial Bonus Conditioned on Worker Performance

In this incentive system, workers receive a financial bonus if they meet some performance requirement within a certain period. The idea behind pay-for-performance is to (i) motivate workers to increase effort and invest in their skills, and (ii) attract and retain highly skilled workers and potentially lose and avoid the hiring of low-skilled workers. The identified studies in this overview focus on the latter showing the causal changes in the overall composition of workers.

Two studies analyze the effects of a pay-for-performance mechanism versus a fixed salary system. Jones and Hartney (2017) find that pay-for-performance causes the attraction of more highly skilled teachers. Chiang et al. (2015), however, find no such effect. However, it should be noted that the designs of the incentive schemes differ in terms of bonus size, evaluation criteria and period of installment.

The three remaining studies focus on the effects of receiving a bonus which is based on teachers' performance. Dee and Wyckoff (2015) and Dee et al. (2021) evaluate the IMPACT program and find that teachers who receive a poor performance evaluation – and thus no financial bonus – are more likely to leave the school district. The authors do not find that high performers are more likely to stay in the school district. Alternatively, Shifrer et al. (2017) do find evidence that high performers are more likely to be retained.

⁵ In line with this finding, Berlinski and Ramos (2020) find that between-school mobility increases which can also be due to the award's potential signaling function.

3.1.6 Financial bonus conditioned on group performance

In this instance, a teacher receives a financial bonus if the group they belong to – e.g. school or district – meets some performance threshold within a certain period. Again, it is not clear a priori what the net effect on employment will be. As with individual bonuses, group pay-for-performance may cause the attraction and retention of more highly skilled workers, and the losing and locking out of low- skilled workers. Nonetheless, four studies estimate the causal effects of group bonus systems on the retention decision of all teachers involved.

The results are mixed. Jones (2013) and Ryu and Jinnai (2021) find that retention is reduced by 14.2 and 3.8 percentage points, respectively. Alternatively, Fryer (2013) and Goodman and Turner (2010) find no retention effects.

To conclude, we find that financial incentives are employed in different ways and yield various outcomes. First, we find that wage increases – both dependent and independent of working conditions and teacher quality – mostly attract and retain teachers. All seven of nine studies confirm the hypothesis that an increase in wages increases the entry of workers and decreases the exit of workers. Second, three studies that document the effect of greater pension wealth contingent on delayed retirement, show affirmative results. Teachers decide to retire at a later point in time – and receive a larger pension – than they would do if they did not receive such compensation. Third, one-time or short-term financial bonuses that depend on working conditions and teacher quality show mostly affirmative results. Especially, six out of nine studies document that financial bonuses can attract and retain teachers when the bonus depends on school or teacher qualities. Finally, pay-for-performance schemes show mixed results. For group bonuses, half of the studies show a significant and negative effect on retention rates whereas other studies document a null effect. For individual bonuses, the positive impacts concentrate on the attraction and retention of high-quality workers as opposed to teachers in general. All studies show an overall null effect. At the same time, some studies show that pay-for-performance incentives either attract high-quality teachers or repel low-quality workers. Importantly, it is difficult to assess *ex ante* whether pay-for-performance incentives will have a net positive effect on the influx of workers.

3.2 Human Capital Investments

Effective on-the-job training and learning increases workers firm- and occupation-specific human capital yielding greater opportunities to prosper on the job (Gibbons & Waldman, 2004; Jovanovic, 1979; Sullivan, 2010). Teachers' and nurses' efforts thereby become more valuable such that they can demand greater financial rewards and have better employment prospects, both in the short- and long-run. Investments in human capital create a bond between workers and their employers (Becker, 1994), therefore contributing to employee commitment and retention (Gross, 2015). We group together interventions that expand teachers' and nurses' skills and/or offer them opportunities to advance their careers. This category includes interventions

such as induction programs directed at beginning teachers, career advancement programs, and initiatives to increase employees' ability to cope with work-related stressors.

3.2.1 Induction Programs

Teacher attrition is particularly pronounced among early-career teachers (European Commission/EACEA/Eurydice, 2019; Schaefer et al., 2012). Beginning teachers' lack of experience in navigating the demands of the profession combined with, e.g., the perceived lack of peer support, hampers the motivation to stay in the profession (Clandinin et al., 2015; Schaefer et al., 2012). Interventions designed to accompany teachers within their first years at the school are called induction programs. These entail extensive guidance for beginning teachers and thus, ease their transition into the teaching profession (Clandinin et al., 2015; Schaefer et al., 2012).

As listed in Table 3, seven studies investigate the effects of induction programs. All of these studies were conducted in the education sector, among them six in the US and one in the Netherlands. One major component of induction seems to be mentoring: two studies exclusively focus on this aspect (DeCesare et al., 2017; Rockoff, 2008), while the remaining induction programs include some mentoring as a component (Glazerman et al., 2010; Helms-Lorenz et al., 2016; Jaciw et al., 2021; Ronfeldt & McQueen, 2017; Schmidt et al., 2020).

Rockoff (2008) studies the effects of a mentoring program among new teachers with less than one year of teaching experience in New York City. Compared to teachers with prior experience, beginning teachers' probability to complete their first school year increases by 4.5 percent following weekly mentoring, thereby reducing turnover (Rockoff, 2008). Similarly, DeCesare et al. (2017) examine a mentoring program in Colorado elementary schools that assigns

Table 3 Overview of studies within the category "Human capital investments"

Author(s) (year)	Intervention group	Treated sample	Level	Design	Outcome
Decesare et al. (2017)	Induction programs	Probationary teachers in first three years at elementary schools in Colorado, US	District	RCT	No effect on retention (0)
Glazerman et al. (2010)		Elementary schools in US	District	RCT	No effect on retention (0)
Helms-Lorenz et al. (2016)		Secondary schools in the Netherlands	School	RCT	Increase in retention (+)
Jaciw et al. (2021)		Final-year university students planning to teach in elementary or middle public schools in Georgia, US	State	PSM	Increase in retention (+)
Rockoff (2008)		Probationary teachers with less than one year experience in US	District	DiD	Increase in retention (+)
Ronfeldt and McQueen (2017)		First year public school teachers in US	Various	PSM	Increase in retention (+)
Schmidt et al. (2020)		Beginning teachers in disadvantaged schools in US	District	RCT	No effect on retention (0)
Dill et al. (2010)	Career advancement programs	Nursing homes in North Carolina, US	State	FE	Increase in retention (+)
Glazerman and Seifullah (2012)		Primary and secondary schools in Chicago, US	District	RCT	Increase in retention (+)
Goldhaber and Hansen (2009)		Teachers in North Carolina, US	State	RCT	Decrease in retention (-)
Pierson et al. (2021)		Early childhood teachers in Oregon, US	State	RCT	No effect on retention (0)
Concilio et al. (2021)	Coping	Newly licensed graduate nurses in California and Pennsylvania, US	State	RCT	No effect on retention (0)
El Khamali et al. (2018)		Intensive care unit nurses in France	Country	RCT	Increase in retention (+)
Kang and Jeong (2019)		Nurses in university hospital in Busan, Korea	Hospital	RCT	Increase in retention (+)
Kang et al. (2017)		Nurses in university hospitals in B-City, Korea	Country	RCT	Increase in retention (+)

The level indicates the level at which the (policy) intervention was implemented. The last column shows whether the study finds an *overall* positive (+), negative (-), or no effect (0) for the full sample. Finally, DiD is Difference-in-differences, FE is Fixed effects, RCT is Randomized control trial, PSM is Propensity Score Matching, and RD is Regression discontinuity.

retired teachers to probationary teachers who are working less than three years within the district. Using an RCT, they find that mentorship by retired teachers in addition to “business-as-usual” mentoring does not significantly affect turnover compared to teachers who only received “business-as-usual” mentoring.

Other studies assess the effectiveness of more comprehensive, multifaceted induction packages (Glazerman et al., 2010; Helms-Lorenz et al., 2016; Jaciw et al., 2021; Ronfeldt & McQueen, 2017; Schmidt et al., 2020). These include a bundle of interventions, such as e.g., mentoring, coaching, peer-support, classroom observations, or professional development over a longer time span of up to three years. In an RCT across secondary schools in the Netherlands, a 3-year induction program for early career support was implemented to retain beginning teachers and increase their commitment to the profession. Helms-Lorenz et al. (2016) find a small and positive significant effect of the program on 3-year retention. Slightly shorter induction programs of 1–2 years in the US show null effects on retention and turnover rates (Glazerman et al., 2010; Schmidt et al., 2020). Notably, two studies investigating the effects of induction programs with propensity score matching do find effects. Ronfeldt and McQueen (2017) find that comprehensive induction support including weekly mentoring, observations, monthly professional development and teacher study groups decrease the probability of beginning teachers moving to another school or another profession.

The CREATE residency program targets teachers in Georgia in an even earlier stage of their career: their final year at university. The three-year intervention entails one year of a pre-service teacher practicum, one year of paired teaching in a single classroom and one year of sole teaching in a single classroom, accompanied by peer-support and a supporting program team. Jaciw et al. (2021) find a positive effect of this residency program on the probability of staying in the teaching profession for at least the duration of the program.

In conclusion, there is no common definition of teacher induction programs. The interventions listed above mostly entail different components, target groups, durations and hence, differ in their effects. Notably, mentoring by experienced teachers seems to be a relevant component of induction programs, but the inconclusive effects across the analyzed studies complicate judging its potential to bolster the retention of beginning teachers. The absence of positive effects in some studies (e.g. DeCesare et al., 2017) might however be explained by the fact that the control group was also subjected to “business-as-usual” mentoring. The effect of the intervention might be different if compared to a control group that is not treated with any type of mentoring.

3.2.2 Career Advancement Programs

Another set of studies focus on programs that either encourage or directly affect the development of workers’ skills as a means to advance in their career. These programs are diverse and range from information nudges to a bundle of potentially effective components – e.g. training and greater responsibilities. While three of the studied interventions target teachers (Glazerman & Seifullah, 2012;

Goldhaber & Hansen, 2009; Pierson et al., 2021), one of the retrieved studies investigates a development program on turnover of nurses (Dill et al., 2010).

In an RCT, Pierson et al. (2021) examine the effect of promoting professional development initiatives on workplace retention of the early childhood education workforce in Oregon, US. Receiving nudges via email, the workforce was encouraged to sign up for a career lattice: a pathway system helping workers to further their education, in exchange for a monetary incentive. The study finds no effect of the email nudges, suggesting that participants might have not sufficiently absorbed the information given in the emails (Pierson et al., 2021).

Glazerman and Seifullah (2012) examine the teacher advancement program (TAP) in Chicago that encourages teachers to take on additional responsibilities and offers extra pay and eligibility for an annual performance bonus. Although no significant effects are found on workforce retention after two years of program implementation, in the third year after the implementation, effects become significant: The retention rate increases by 11.5 percentage points compared to the control group (Glazerman & Seifullah, 2012).

To improve nurses' work environment and decrease turnover, Dill et al. (2010) investigate the WIN A STEP UP program. Next to providing education on clinical and interpersonal topics, the program committed participants to stay in their jobs for three months and provided retention bonuses and/or raises upon completion. Nursing facilities' likelihood of having below-average turnover increased by 15 percentage points when participating in the intervention.

Finally, Goldhaber and Hansen (2009) study important side-effects of skill development when this leads to accredited certification. Due to the certificate's signaling power in the labor market, certified teachers might be inclined to pursue alternative jobs. Goldhaber and Hansen (2009) examine the impact of the National Board of Professional Teaching Standards (NBPTS) certificate within a regression discontinuity framework. They find that teachers just above the eligibility cutoff for certification are more likely to leave their school, district, and state four years after certification compared to their counterparts just below the eligibility cutoff. In the case that certified teachers stay within the state, they tend to sort out of disadvantaged schools. These findings point towards a double-edged sword of human capital investments: As investments in skills become more general, this may induce greater turnover as teachers' enhanced skills allow them to work in more favorable schools or professions.

3.2.3 Coping

Within the healthcare literature, four retrieved studies examine nurses' turnover behavior and intentions following interventions that we group under Coping. Instead of changing nurses' direct work environment, coping interventions are aimed at increasing nurses' resilience and equipping them with skills to better cope with the stressors of their profession. Therefore, the increased ability to cope with demands such as stress and workplace bullying are expected to affect nurses' turnover.

El Khamali et al. (2018) study a stress-management intervention for intensive care unit (ICU) nurses in France. This intervention entails a 5-day course recapping nursing theory and stimulating situational role-play in simulated scenarios. It aims to reduce job strain through enabling ICU nurses' to cope with various stressors. In an RCT, the intervention achieves a significant, 8 percentage points reduction of turnover in the treatment group after 6 months. Concilio et al. (2021) use a digital intervention in the form of supportive text messages to increase social support, resilience and nurses' ability to cope with stress. In an RCT, they find no significant effects on turnover intentions.

Kang and Jeong (2019) as well as Kang et al. (2017) analyze "cognitive rehearsal" interventions, which are aimed to increase the ability to cope with workplace bullying and mitigate the turnover intentions of nurses. The intervention developed by Kang et al. (2017) entails 20 direct contact hours, and Kang and Jeong (2019) examine a respective smartphone application. Both interventions are associated with slightly declining turnover intentions of nurses within a small sample. These studies suggest that coping interventions, particularly those involving multi-day training programs, can effectively reduce turnover.

3.3 Organizational Features

In this section, we discuss the results of various studies investigating how organizational features affect teachers' and nurses' employment decisions. First, we discuss how various aspects of the organizational climate, including leadership, affect teacher behavior. Second, we discuss how the work and task design of jobs can either in- or decrease the work pressure or autonomy of workers, and thereby affect behavior.

3.3.1 Climate and Leadership

Hoy (1990) conceptualizes school climate as "a broad term that refers to teachers' perceptions of their general work environment; it is influenced by the formal organization, informal organization, personalities of participants, and the leadership of the school" (p. 151). Hypothetically, teachers would be more willing to commit to a school if it offered a pleasant school climate enabling social, emotional and physical safety (Grant et al., 2022; Kraft et al., 2016).

Of the retrieved studies, Kraft et al. (2016) examine four dimensions of school climate (leadership, expectations, relationships and safety) and their effect on teachers' exit rates. They indeed find that an improved school climate reduces teacher turnover. Notably, leadership is the strongest dimension in predicting turnover reduction (Kraft et al., 2016). Grant et al. (2022) study another intervention aimed at improving school climate: *Restorative Practices*. The intervention reforms disciplinary measures within the school community by addressing inappropriate behaviors among students in a proactive and empathetic way. They investigate the intervention in the context of another intervention called *Diplomas Now*, fostering teamwork

among teachers and small learning communities, among others. While the interventions indeed have a positive effect on the school climate, they do not significantly affect teacher turnover (Grant et al., 2022).

Two studies specifically focus on the improvement of school leadership through development programs targeting school leaders. The *Balanced Leadership Program* investigated by Jacob et al. (2015) aims to increase principals' self-efficacy by teaching them 21 key leadership responsibilities that are significantly related to student achievement. Two years after the implementation of the program, treated schools witness a 5 percentage point decrease of teacher turnover. Similar yet less sizable effects were found by Steinberg and Yang (2022), who examined the *Pennsylvania Inspired Leadership Induction Program*, consisting of two courses to establish three core leadership standards within the first five years of appointment to principal. Treatment schools experience a significant decline in teacher turnover in the second and third year after program completion.

Finally, Grissom and Bartanen (2019) analyze how the effectiveness of principals influence strategic personnel management. They find that especially effective principals increased retention among the most effective teachers and increased turnover among low-scoring teachers in the state of Tennessee. They also find that more effective principals reduced teacher turnover on average.

3.3.2 Work and Task Design

Another important feature of organizations is how tasks are designed and how work is organized. Public press increasingly reports about teachers and nurses taking on tasks that they dislike and did not sign up for – e.g. administrative duties.⁶ Such duties may increase work pressure and decrease job satisfaction such that the likelihood of turnover increases. Two papers in our sample study how the intensity of certain tasks influence turnover decisions. Minor et al. (2019) examine a Michigan curriculum change that increased the number of courses required for graduation, leading to increased work pressure for teachers. They find that, after the announcement of the curriculum change in 2006 as well as 4 years later in 2010, school-level teacher turnover increases significantly around 4.3 percent compared to 2004. Hence, reducing the work pressure through a curriculum change might decrease turnover. Fuchsman et al. (2020) study reduced testing in certain subjects and grades in Georgia public schools as an intervention to decrease work pressure and turnover. They find that the removal of certain testing requirements had little to no effect on the probability of overall teacher turnover. However, heterogeneity analyses reveal that early-career teachers consistently became less likely to leave their profession in response to reduced testing requirements.

⁶ <https://www.weforum.org/agenda/2023/01/healthcare-workloads-and-staff-shortages-davos23/>
<https://nos.nl/artikel/2167480-basisschoolleraan-werkdruk-vooral-door-administratieve-rompslomp>
<https://nationalpost.com/news/canada/studies-show-teachers-buried-in-admin-work-have-less-time-for-students>

For healthcare workers, a common catalyst for work pressure is related to the limited accommodation of work-life-balance due to strict time scheduling (Tausig & Fenwick, 2001). A way to modify the constraints in balancing work time with other responsibilities, is by increasing flexibility of working times. Choi et al. (1986) investigate the effect of an intervention aiming to increase flexibility in shift scheduling for nurses in an RCT. However, Choi et al. (1986) do not find significant differences in turnover intentions between the control and treatment group.

A number of studies also look at the task content of nurse practitioners' jobs. In the US, nurse practitioners have different authorizations depending on the state and the respective scope of practice (SOP) regulations. Full SOP regulated counties permit nurse practitioners to evaluate patients, pose diagnoses, initiate treatments and prescribe medications. Reduced SOP regulations limit nurse practitioners' permission in one of these areas and require collaborative agreement with an outside health discipline, while restricted SOP regulations additionally require supervision delegation and team management by an outside health discipline (DePriest et al., 2020; Kandrack et al., 2021; Xue et al., 2018). Overall, extended SOP regulations aim at reorganizing healthcare supply to reduce the inequity of nurse practitioner supply in over- and underserved areas. Simultaneously, an extended SOP enriches nurse practitioners' work by increasing task variety, hypothetically diversifying their skills use.

All three retrieved studies exploit the variation in these regulations to measure their effects on the supply of nurse practitioners. Xue et al. (2018) find that full SOP regulation is associated with a higher supply of nurse practitioners in rural and shortage areas compared to countries with reduced or restricted SOP regulations. Likewise, DePriest et al. (2020) finds that the implementation of full SOP increases the probability of nurse practitioners living near or in high shortage areas. In contrast, Kandrack et al. (2021) find null effects of adopting full SOP regulations on nurse practitioners' supply.

3.4 School Accountability and its Consequences

School accountability has become increasingly common around the world and implies that schools are being evaluated based on student performance. On the basis of these evaluations, schools receive explicit or implicit rewards or sanctions (Figlio & Loeb, 2011). For example, schools that meet performance expectations may receive increased resources or autonomy, as well as bonuses for educators. Underperforming schools might experience increased pressure from stakeholders to improve performance or might even be forced into a school turnaround.

Accountability systems may both increase and decrease teacher turnover in the short- and long-run. The *ex ante potential* rewards or sanctions may motivate both school management and teachers to perform better. Accountability puts more emphasis on students' test performance, which can increase pressure on teachers and make their profession less attractive. Moreover, information about teacher effectiveness – together with greater accountability pressure – can induce school leaders to exert more effort into dismissing their less effective teachers, but also into keeping their most effective teachers. The *actual ex post* receiving of rewards or sanctions

Table 4 Overview of studies within the category “Organizational features”

Author(s) (year)	Intervention group	Treated sample	Level	Design	Outcome
Grant et al. (2022)	Climate and leadership	Low-performing secondary schools across US	District	RCT	No effect on retention (0)
Grissom and Bartanen (2019)		Primary and secondary schools in US	State	FE	Increase in retention (+)
Jacob et al. (2015)		Rural schools in Northern Michigan, US	State	RCT	Increase in retention (+)
Kraft et al. (2016)		Secondary schools in New York City, US	City	FE	Increase in retention (+)
Steinberg and Yang (2022)		Public and charter schools in Pennsylvania, US	State	DiD	Increase in retention (+)
Choi et al. (1986)	Work and task design	Registered nurses and licensed practical nurses in hospital in the US	Hospital	RCT	No effect on retention (0)
DePriest et al. (2020)		States across the US	State	DiD	Increase in retention and entry (+)
Fuchsmann et al. (2020)		Public Schools in Georgia, US	State	DiD	No effect on retention (0/+)
Kandrack et al. (2021)		States across the US	State	DiD	No effect on retention or entry (0)
Minor et al. (2019)		Secondary schools in Michigan, US	State	FE	Decrease of retention (-)
Xue et al. (2018)		States across the US	State	FE	Increase in retention and entry (+)

The level indicates the level at which the (policy) intervention was implemented. We only report effects on the full sample, unless studies only perform subsample analyses. Heterogeneous effects are discussed in the text. The last column shows whether the study finds an *overall* positive (+), negative (-), or no effect (0) for the full sample. In the case that a study reports an overall null effect, but a positive effect for a subsample, the table reports (0/+). DiD is Difference-in-differences, FE is Fixed effects, RCT is Randomized control trial

– consequences of being held accountable – in turn can have severe direct effects on turnover – e.g., if a pre-defined fraction of teacher staff is laid off.

Although school accountability systems – and their consequences – do not directly address acute teacher shortages, it is important to recognize that these systems are put in place to improve educational quality. As a result, accountability measures have an indirect effect on employment, particularly in relatively low-performing schools. Incentive schemes that motivate schools to improve school and educational quality may make schools and the teaching profession more attractive (e.g., Grissom et al., 2014). It might therefore be viewed as an indirect way to reduce future shortages and may significantly influence the future attraction and exits of teachers.

In the next section, we first discuss six studies that analyze the incentive effects of accountability systems on teacher labor markets as a whole. These studies investigate what happens to teachers as a consequence of specific accountability systems. In the second part of this section, we synthesize the findings of twelve studies from the US that look specifically into the explicit consequences of school accountability, such as turnarounds of persistently low-performing schools, and how these consequences affect the inflow and outflow of teachers. The findings of the studies discussed in this section are summarized in Table 5.

3.4.1 Incentive Effects of School Accountability

In the US, the passage of the “No Child Left Behind Act” (NCLB) in 2002 marked the starting point of high-stakes accountability reforms. NCLB required states to test students and, based on test outcomes, evaluate whether schools met the state’s yearly improvement targets. Due to NCLB, students’ parents were better informed about how their children’s schools were performing. Schools that did not meet improvement targets could be labeled as “needing improvement”. NCLB only entailed explicit penalties for schools with many low-income students or specific racial/ethnic subgroups (so-called “Title I schools”) that did not meet the improvement goals

Table 5 Overview of studies within category “School accountability and its consequences”

Author(s) (year)	Intervention group	Treated sample	Level	Design	Outcome	
Brunner et al. (2019)	Incentive effects of school accountability	Low-performing, high-poverty schools in US	State	DiD	No effect on retention (0-)	
Cullen et al. (2019)		Primary and secondary schools in US	District	DiD	No effect on retention (0-)	
Grissom et al. (2014)		Primary and secondary schools in US	Country	DiD	No effect on retention (0+)	
Robertson-Kraft and Zhang (2016)		Primary and secondary schools in US	District	DiD	No effect on retention (0-)	
Shirrell (2018)		Primary schools in US	Country	RD and DiD	No effect on retention (0+)	
Sun et al., (2017a, 2017b)		Grades 3-4 in US	Country	DiD	No effect on retention (0)	
Bacolod et al. (2012)		The effects of sanctions and rewards embedded in school accountability	Primary and secondary school in US	State	RD	No effect on retention (0)
Carlson and Laveru (2018)			Low-performing primary, middle, and high-schools in US	State	RD	No effect on retention (0)
Dizon-Ross (2018)			Primary and middle-schools in US	City	RD	No effect on retention (0+)
Feng et al. (2018)			Primary and secondary schools in US	State	RD	No effect on retention (0-)
Gjefsen and Gunnæs (2020)	Lower-secondary schools in Norway		City	DiD	No effect on retention (0)	
Heissel and Ladd (2018)	Low-performing primary and middle-schools in US		State	Fuzzy RD	Decrease in retention (-)	
Henry et al. (2020)	Low-performing primary and secondary schools in US		State	DiD	Increase in entry (+)	
Henry and Harbatkin (2020)	Low-performing primary and secondary schools in US		State	Fuzzy RD	Decrease in retention (-)	
Lee and Sartain (2020)	Under-enrolled primary schools with low accountability ratings in US		District	DiD	Decrease in retention (-)	
Pham et al. (2020)	Low-performing primary, middle, and high-school schools in US		State	DiD	Decrease in retention (0-)	
Pope (2019)	Primary schools in US	Primary schools in US	District	FE	No effect on retention (0)	
Sun et al., (2017a, 2017b)			District	DiD	No effect on retention (0)*	

The level indicates the level at which the (policy) intervention was implemented. The last column shows whether the study finds an *overall* positive (+), negative (-), or no effect (0) for the full sample. In the case that a study reports an overall null effect, but a positive or negative effect for a subsample, the table reports (0/+) or (0/-). DiD is Difference-in-differences, FE is Fixed effects, RD is Regression discontinuity

*Sun et al., (2017a, 2017b) find an increase in involuntary teacher mobility, but we consider voluntary mobility as the most important outcome measure since our study aims to investigate how teachers can be incentivized to remain in teaching or enter the profession

set by the state. These penalties included a change of the school’s leadership team or even school closure.

Sun et al., (2017a, 2017b) find that NCLB increased the odds of involuntary leaves yet had no effect on voluntary mobility (transfer to other schools) and voluntary attrition (leaving the teacher profession) among teachers. Similarly, Grissom et al. (2014) find no evidence that NCLB decreased teachers’ intention to remain in teaching. The intent to remain in teaching even became higher in high-poverty schools compared to low-poverty schools, despite the fact that these schools faced the threat of sanctions (Grissom et al., 2014). Shirrell (2018) also finds no effect of the subgroup-specific accountability policies on overall teacher exits. The policy actually caused black teachers who were held accountable for the black student subgroup to leave teaching at significantly lower rates. These findings suggest that NCLB did not make the teacher profession less attractive and may even encourage teachers to stay.

Another set of studies analyze a specific component of school accountability systems: Teacher evaluations which contain both novel, more intensive evaluation methods and policies to reduce teachers’ employment protection. According to Brunner et al. (2019), “Proponents argue that [evaluations] will make it easier to identify and remove ineffective teachers and reduce administrative constraints over human capital ... [while] opponents counter that these reforms make teaching a less attractive profession, leading to an increase in attrition...” (p. 403). Brunner et al. (2019) study the effect of Michigan’s teacher evaluation reform, while Robertson-Kraft and Zhang (2018) analyze the impact of a teacher evaluation system in Texas. Both studies find that the teacher evaluation systems had no effect on average teacher

turnover, although the policies did increase exits among early career and low-quality teachers.

One study focuses directly on how teacher evaluations affect strategic personnel management. In response to a rigorous teacher evaluation implemented by the Houston Independent School District, Cullen et al. (2021) find that less effective teachers became more likely to exit the school or district.

To conclude, none of the studies offer convincing evidence that school accountability policies – and the underlying teacher evaluations – have a negative effect on teachers' (willingness to) leaving their school or profession. However, a few studies do find that increased accountability pressure can increase turnover among early-career teachers. In some instances, accountability measures actually increased teacher retention. Improved information about teacher performance can help schools to retain their most effective teachers. Moreover, accountability pressure might also encourage schools to improve student achievement and make their schools a more desirable workplace.

3.4.2 The Effects of Sanctions and Rewards embedded in School Accountability

The academic standards set by accountability policies in the US have increased awareness of the persistently poor performance of certain schools and have led to explicit consequences for these schools. As a response, the federal government provided more than US\$7 billion in resources to stimulate states and districts to implement federally approved turnaround reforms through School Improvement Grants (SIG) and Race to the Top (RttT) funds.

These federally mandated turnaround measures were based on the belief that incremental changes in school learning processes would be insufficient to achieve significant school performance gains and involved specific practices for disrupting the status quo (Henry et al., 2020). States that received federal turnaround funds through RttT and SIGs were required to employ one of four specific models: (1) the transformation model, (2) the turnaround model, (3) the restart model, or (4) school closure. The transformation model required schools to replace the principal, take measures to increase teachers' and principals' effectiveness, and introduce comprehensive instructional reforms, amongst other things. The turnaround model included all of the requirements of the transformation model, but additionally required schools to replace at least half of their teaching staff. Under the restart model, schools had to transfer school management responsibilities to an independent entity such as a charter management organization.

Most school districts that implemented turnaround interventions under RttT and SIG selected either the transformation or turnaround model. Six of our included studies analyze the effects of these two models and report mixed effects on teacher retention. In North-Carolina, where 85 percent of the schools opted for the transformation model, teacher turnover increased after the first full year of program implementation (Heissel & Ladd, 2018). Sun et al., (2017a, 2017b) find that the transformation and turnaround models in the San Francisco Unified School District caused a weak increase in involuntary teacher mobility. Importantly, the turnaround models had no significant effect on voluntary teacher mobility. While Carlson and Lavertu

(2018) report no significant effect on average teacher retention of Ohio's SIG turnaround efforts, descriptive heterogeneity analyses suggest that the transformation model increased teacher retention, while the turnaround model led to a reduction in teacher retention. Tennessee allowed its lowest-performing schools to join a so-called Innovation Zone (iZone) which implemented reforms aligned with the transformation model. While iZones were not required to replace their teachers, almost all iZone schools did replace at least 50 percent of teachers. Pham et al. (2020) find that teacher turnover was not significantly affected in the five year period after iZone schools were installed.

Tennessee also placed some of its lowest-performing schools into an Achievement School District (ASD). The ASD implemented the restart model by reopening schools under new management and required schools to replace their principal and at least 50 percent of their teachers. Pham et al. (2020) find that ASD schools experienced increased teacher turnover. After the intentional staff replacements, turnover continued to be high in the years after the introduction of the reform. Henry et al. (2020) show that both ASD and iZone schools increase the proportion of entering teachers which is also partly explained by the initially high teacher turnover.

Two studies in our review examine the impact of turnaround initiatives that were not federally mandated. Under the Every Student Succeeds Act (ESSA) that was installed in 2015, states received more flexibility in how they reformed their lowest performing schools. The North Carolina Transformation Initiative implemented two-day visits by the Department of Public Instruction staff who collected data through classroom observations, interviews, and focus groups. After this assessment phase, schools submitted an improvement plan, which was followed by school transformation coaching with the goal of building leadership and teaching capacity. Henry and Harbatkin (2020) find that teachers in treated schools were more likely to leave the school than teachers in control schools one year after the implementation.

One study investigates the most rigorous consequence for low-performing schools. The Chicago Public Schools identified 330 under-enrolled schools, some of which were also suffering from low accountability ratings. Although all schools faced initial threat of closure, the Chicago Board of Education voted to close 47 elementary schools. Lee and Sartain (2020) find that teachers in closed schools were more likely to leave the school district compared to teachers in under-enrolled and low-performing schools that faced initial threat of closure and teachers in schools that were never at risk.

While most of the accountability studies have analyzed the impact of (in-)direct sanctions for poor performance such as school turnaround and school closures, Bacolod et al. (2012) examine the effects of financial awards for high performing schools and teachers in the California Public School system. Many of the awards were distributed as teacher bonuses. Bacolod et al. (2012) find no evidence that the financial awards increased teacher hiring. The authors argue that this finding could be explained by the fact that the financial awards were typically short-lived (2 years).

Feng et al. (2018) examine the impact of a 2002 change in Florida's grading system, which recalibrated acceptable student proficiency levels for school accountability. This change caused an "accountability shock," altering grades for half of the schools, with some receiving higher and others lower grades. High-performing

schools receive rewards, while low-performing schools receive sanctions as well as additional assistance. Grading shocks generally did not affect teacher mobility, except in the lowest-performing schools, where a downward grade shock increased the likelihood of teachers leaving the school. In contrast, Dizon-Ross (2020) finds that publishing school grades decreases teacher turnover at the bottom end of the grade distribution.

Finally, performance ratings of schools and teachers have increasingly become publicly available. Poorly performing schools or teachers can experience increased pressure to improve once community stakeholders are informed about their performance. Two of our selected studies look at the impact of the publication of teacher ratings in Los Angeles and Oslo. None of these studies find that the publication of teacher ratings affects teachers' likelihood to leave the school district or switch to a new school or grade (Gjefsen & Gunnes, 2020; Pope, 2019).

In sum, the impact of school turnarounds and other evaluation system outcomes on teacher employment are mixed. Many schools intentionally replaced a large share of their teaching staff which caused high turnover rates. Under some turnaround models, teacher turnover continued to be high, potentially due to organizational instability. However, some turnaround initiatives also increased schools' ability to retain and recruit high performing teachers. It is difficult to explain why some schools managed to positively affect the quality of their teacher composition as the turnaround initiatives widely varied across school districts and states. Other reward or sanctioning outcomes – such as the publication of teacher grades – seem to cause little changes in teacher employment.

3.5 Other Interventions

A total of eleven studies could not be distinctly grouped into one of the preceding categories and will therefore be discussed individually. Retrieved studies addressing teacher turnover cover various types of schools (Barrett et al., 2022; Hensvik, 2012; Roch & Montague, 2021), the extension of the probationary period (Goldhaber et al., 2016), a strategy for alternative teacher preparation (Curran, 2017; Hansen et al., 2016), and recruitment and retention initiatives (Guffey & Young, 2020). In the healthcare context, we retrieved isolated studies on a parental leave program (Friedrich & Hackmann, 2021), staffing requirements (Chen & Grabowski, 2015; Han et al., 2021), and insurance reimbursement policies (He et al., 2020).

3.5.1 Type of Schools

Schools can operate in different markets and have distinct core features. For instance, private schools are typically free from union contracts and strict employment regulations, which can attract high-quality teachers due to increased flexibility. Hensvik (2012) examines the expansion of private schools in Sweden between 1991 and 2006 and finds that teachers moving from public to private schools have above average cognitive skills, indicating that private schools are more appealing

for high-quality teachers. Additionally, private schools relax formal teacher requirements and attract workers from the private sector.

Barrett et al. (2022) compare deregulated market-based schools and traditional school districts in the US. They find that market-based schools, which operate without union contracts and have autonomy in hiring, dismissal, and compensation, better retain high-quality teachers. Teachers with higher value added are less likely to leave these schools compared to traditional ones. Both Hensvik (2012) and Barrett et al. (2022) suggest that flexible personnel policies help attract and retain high-quality teachers.

Roch and Montague (2021) study K-12 online schools and their impact on teacher retention and job satisfaction. Despite challenges such as larger student–teacher ratios, higher shares of low-income and minority students, and lower salaries, Roch and Montague (2021) find no significant difference in teachers' intention to leave the profession or to move to a new school compared to traditional schools. Surprisingly, online teachers report higher job satisfaction, possibly due to greater personal autonomy. However, further research is needed to understand what drives teacher satisfaction in the online environment.

3.5.2 Probationary Period

A key element of public-school teaching is to reach job protection after a given number of years in the profession, so-called tenure. Tenure, as well as its timing, determine the attractiveness of a teaching career. Goldhaber et al. (2016) investigate a policy change in North Carolina and Washington State that extended the time to tenure by one year. Untenured teachers' mobility patterns intensified exclusively in North Carolina in response to the policy change: pre-tenure teachers were 2–3 percentage points more likely to exit their school district or state. Teachers who otherwise would have received tenure in the year of the policy change were 1–2 percentage points less likely to leave their district.

3.5.3 Alternative Teacher Preparation

Alternative routes to teaching, like the Teach for America (TFA) program, remove barriers to enter the profession. TFA was initially introduced in high-shortage areas and prepared recent high-achieving college graduates to become full-time teachers within five weeks. Curran (2017) suggests that TFA placements may threaten fully certified teachers in non-shortage areas, finding that TFA presence in a district predicts 11–14 fewer teacher vacancies annually. Similarly, Hansen et al. (2016) note that increased TFA density raises overall teacher mobility out of school districts but decreases TFA teachers' probability of switching schools. These findings indicate that while TFA placements may affect the retention of the regular teaching workforce, they do not reduce the overall teacher supply.

3.5.4 Recruitment and Retention Initiatives

Attracting and retaining teachers may also improve in effectiveness if granted more funding. The STAR program explored by Guffey and Young (2020) allocated \$8000 per year to strategic recruitment and retention initiatives for agriculture teachers. Specifically, funded recruitment initiatives entail promotion at conventions in high schools and universities, while retention initiatives include workshops, mentoring, work-life-balance and professional development. State enrollment in this program significantly increased the recruitment of alternatively-certified agriculture teachers approximating to, on average, 10 new hires compared to control states and prior to the intervention. Effects on retention as well as the placement of fewer new vacancies were insignificant.

3.5.5 Parental Leave Program

Friedrich and Hackmann (2021) analyze the unintended effect of a federally funded parental-leave program in Denmark on the nurse shortage that the country was facing at the time the policy was implemented. The policy was introduced in 1994 and allowed parents to take up one year's absence per child aged up to eight years. The program intended to give unemployed individuals the opportunity to fill the open positions and gain valuable work experience. The program also offered job security and a compensation of 80 percent of unemployment benefits. Friedrich and Hackmann (2021) find that the reform reduced the employment of hospital nurses with 15 percent, while the employment of nurses in nursing homes decreased by 10 percent. In contrast, the policy had no significant effect on the employment of nursing assistants in hospitals and nursing homes.

3.5.6 Staffing Level (requirements)

Two studies investigate the impact of (minimum) staffing requirements and insurance reimbursement policies on nursing staffing levels. Chen and Grabowski (2015) analyze California's AB 1731 law, which required nursing homes to raise the minimum nursing staff requirement from 3.0 to 3.2 h of direct resident care per day. Similarly, Ohio increased its minimum total direct care hours from 1.6 to 2.75 in 2002. Both states experienced an increase of 0.175 total nursing hours per resident in all three post-intervention years. Because the minimum staffing standard included all direct care workers, the policy change led to the hiring of additional certified nursing assistants (CNAs) and licensed practical nurses (LPNs), rather than registered nurses (RNs) who incur higher wages.

Han et al. (2021) assess whether different legislative approaches increase the nurse staffing in hospitals. Compared to states with no staffing legislation, the state that legislated minimum staffing ratios had a 0.996 increase in RN hours per patient day and a 0.224 increase in NAP hours. The staffing committee approach (which comprised at least 50% RNs who are involved in developing the staffing plan) had a negative effect on LPN hours, while the public reporting of staffing levels approach had a positive effect on LPN hours.

He et al. (2020) examine the effect of Medicare reimbursement policy changes in 2006. They find that relative to facilities without patients reimbursed by Medicare, a 5 percent increase in Medicare payment raised RNs' hours per resident day by 9 percent and LPNs' hours by 10 percent. Although higher reimbursement payment increases the demand for nurses, it is unclear whether it also affects the overall supply of nurses.

4 Concluding Discussion

4.1 Summary and Discussion of the Results

This study systematically reviewed 85 studies documenting the causal effects of interventions and policies that address nurse and teacher shortages. The systematic search yielded studies that are predominantly from the US, with a majority of studies focusing on education. The most widely exercised identification strategy is the difference-in-differences approach. The retrieved studies contain a wide range of different interventions that are ultimately classified in five different intervention categories. The biggest category examines the effect of financial incentives – in different shapes and forms – on entry and exit of teachers or nurses. Other categories include human capital investments, organizational features and accountability policies. Table 6 provides an overview of the main findings with the percentages of studies showing positive, negative or no effects on employment. Overall, we find that 44 percent of the studies document an overall positive effect on retention and entry, 46 percent show null effects and the remaining studies document negative effects on employment.

Financial incentives marks the largest intervention category and shows overall positive effects on teacher employment. The differences in effectiveness between incentive designs are large, however. Studies that look at wage increases – both independent and dependent of working conditions or teacher quality – largely show positive effects on employment. Only wage increases caused by union bargaining – over a fixed education budget – may yield negative employment effects. Also, pension reforms in which employees receive greater pension wealth if they delay their retirement decision cause employees to work longer. Likewise, financial bonuses that depend on working conditions or teacher quality reveal overall positive effects. Finally, the implementation of pay-for-performance schemes – either based on individual or group performance – mostly do not attract or retain more employees. This is not surprising, as they a priori can both attract higher-quality workers and push away lower-quality workers who become demotivated when they are not eligible for receiving a bonus. Interestingly, even studies that focus on the quality composition of the workforce do not find corroborative evidence. Our synthesis of the literature thus suggests that wage increases generally attract more teachers, but only under the condition that these wage increases do not restrict the number of teachers that can be hired. Financial bonuses, on the other hand, are particularly effective if they are dependent on working conditions and teacher quality, but not on teacher performance. However, financial bonuses are typically paid once and it remains unclear whether these bonuses are also effective in retaining teachers in the long-run.

Table 6 Percentage of studies with employment effects per intervention category

Intervention categories	No effect on employment	Increase in employment	Decrease in employment	N
Financial incentives	37%	53%	10%	30
Wage increase conditioned on working conditions	0%	100%	0%	4
Unconditional wage increase and frontloading	20%	60%	20%	5
Greater pension conditioned on delayed retirement	0%	100%	0%	3
Financial bonus conditioned on working conditions and teacher quality	33%	67%	0%	9
Financial bonus conditioned on worker performance	100%	0%	0%	5
Financial bonus conditioned on group performance	50%	0%	50%	4
Human capital investments	33%	60%	7%	15
Induction programs	43%	57%	0%	7
Career advancement programs	25%	50%	25%	4
Coping	25%	75%	0%	4
Organizational features	36%	55%	9%	11
Climate and leadership	20%	80%	0%	5
Work and task design	50%	33%	17%	6
School accountability	78%	5%	17%	18
Incentive effects	100%	0%	0%	6
Reward or sanction effects	67%	8%	25%	12
Other	45%	45%	9%	11

Summarized overview of the studies' main effects on employment per intervention category. Boldfaced intervention categories represent the main categories. Information on effects from subsample analyses can be found in Tables 2, 3, 4 and 5

Interventions that entail *Human capital investments* show positive effects on the entry and retention of teachers and nurses in 60 percent of the studies. Studies that analyze the effects of *Coping* most often report positive impacts on employment in nursing. This category comprises of studies examining stress management and anti-bullying interventions. *Induction programs* focus on the skill enhancement, social ties and professional development of beginning teachers. Here, we see that four out of seven studies provide evidence that induction programs are more likely to retain teachers. While mentoring by experienced teachers is a common element of induction programs, the analyzed interventions vary substantially in their components and intensity which might explain why the effects differ across studies. The absence of positive effects in some studies might also be explained by the fact that the control group was also treated with a type of mentoring. The *Career advancement programs* encourage the development of workers' skills to advance in their career. While two studies find a positive effect of offering training on the retention of nurses and teachers, another study also shows that the certification of skills can lead to teacher attrition as its signaling power increases the pursuit of job opportunities outside the education sector. One study analyzing the impact of nudging teachers to learn about the

existence of a career advancement program found no effect. From our systematic literature review, we conclude that coping interventions – especially if they involve direct contact hours – are an effective way to retain nurses. In addition, career advancement programs are effective in retaining both teachers and nurses once individuals are actually enrolled in such programs, i.e. solely informing individuals about the existence of such programs might be insufficient. Finally, induction programs could promote the retention of teachers, but further research is needed to understand which elements effective inductions programs contain.

The selected studies that analyze aspects of *Organizational features* provide some evidence that interventions aiming to improve *Climate and leadership* can reduce teacher turnover. Notably, leadership seems to be an important dimension of school climate in predicting turnover reduction (Kraft et al., 2016). This is confirmed by three studies that consistently demonstrate that improved leadership translates into increased teacher retention. The studies that investigate interventions that affect *Work and task design* often report null effects, where one study shows that increased work pressure induced by a curriculum change increases turnover among teachers. It is, however, unclear from this study whether a reduction in work pressure would reduce turnover. Finally, our review also offers some evidence that increasing the *Scope of practice* regulations might increase the supply of nurses in shortage areas. From our systematic literature review, we synthesize that establishing strong leadership can be particularly effective in increasing teacher retention, whilst expanding the scope of practice can be an effective way to attract nurses. Broadening nurses' scope of practice also increases the flexibility in assigning nurses to tasks (van Merode et al., 2024). However, it should be noted that increasing the scope of practice of nurses also requires more coordination at the level of healthcare units, departments or even organizations. An increase in coordination efforts requires slack time and the availability of slack resources in turn depends on a stable inflow and retention of nurses (van Merode et al., 2024).

A substantial part of the *School accountability* studies focus on *Incentive effects* – i.e. reacting to the potential “carrot” or “stick” – which involve the process of evaluating school performance and tying consequences (e.g. school closure or extra funding) to such evaluation. We find that none of the accountability studies document positive main effects on teacher employment. It is important to note that a priori the incentive effect does not imply a greater entry or retention of teachers as structural changes to improve school quality might include smaller (e.g., retaining all staff) or larger (e.g., changing teacher composition) turnover. Moreover, studies on *Reward and sanction effects* embedded in school accountability and a consequence of evaluation provide dispersed evidence on employment effects. Approximately 8 percent of the studies show an increase in net influx whereas a quarter of the studies show a decrease. School turnaround as the largest set of interventions follows from a sufficiently low evaluation and contains drastic measures. In some instances, it entails the dismissal of 50 percent of staff whereas in others it may imply better management and working conditions for teachers. Unfortunately, the included studies offer little insight into whether turnaround schools create more attractive working conditions for teachers in the long-run. More research is required to understand

whether school accountability and school turnarounds can increase the inflow and retention of teachers in the long-run through improved school quality.

Finally, the *Other* category offers some interesting findings. For example, *Alternative teacher preparation* programs such as Teach for America (TFA) ease individuals' selection into the teaching profession. Although the studies included in our review show that TFA teachers might replace regular teachers in non-shortage areas, they find no effect on the overall supply of teachers. Hence, in shortage areas, programs like TFA might increase the supply of teachers. The *Other* category also contains studies that look into the unintended effects of policies. For example, one Danish study finds that the implementation of a generous parental-leave program can exacerbate the shortage of nurses.

4.1.1 Education and healthcare

The systematic search retrieved articles on intervention effects for both teachers and nurses. A key contribution of this study is to compare effective interventions between sectors that have not been discussed in literature reviews that focus on one sector specifically. With respect to nursing, the following interventions are evidently effective in education yet not discussed in Park and Yu (2019) – a recent literature review on effective interventions in nursing – and may thus be beneficial to nurse employment. *Induction programs* can prove to be an effective vehicle to increase nurse employment since young, early-career nurses show a relatively higher probability of transitioning out of the profession (Kox et al., 2023). In particular, elements of induction programs, such as mentoring, coaching, and peer-support schemes can be integrated in early-career nursing programs or residency programs. Moreover, we document specific types of *Financial incentives*, such as conditional wage increases or financial bonuses, that pertain solely to teacher labor markets. The implementation of these reward policies may, however, also attract and retain nurses. For example, providing nurses with a conditional bonus for working at hard-to-staff hospitals may yield solutions to regional shortages of nurses. Additionally, we only retrieve studies about effective *Climate and leadership* interventions in the educational sector. Earlier work in the healthcare sector has stressed the positive relationship between high-quality leadership and nurses' intent to stay (Cowden et al., 2011). Our study corroborates this finding by showing how improved leadership quality causally increases actual employment.

Second, *Coping* and *Scope of practice regulations* interventions are solely analyzed in the context of healthcare and not education. The literature review of See et al. (2020) about effective teacher interventions does not discuss studies in the educational sphere oriented towards coping with stress or increased scope of practice. Akin to the previous argument for the healthcare sector, the educational field may benefit from the insights about coping interventions as teachers battle with stress and burnout. Fahie and Devine (2014) describes the relatively high incidence of workplace bullying in the educational sector, for example. The effective treatment that deals with workplace bullying for nurses by Kang et al. (2017) may offer a solution to this problem and retain teachers. Moreover, granting

teachers greater responsibilities and other tasks may prove to be an important part of professional development to attract and retain teachers.

To conclude, various interventions can attract and retain workers in the education and healthcare sectors. For both sectors, induction programs with mentoring, coaching, and peer-support elements can help retain early-career professionals. Financial incentives such as conditional wage increases and bonuses can address staffing challenges, particularly in hard-to-staff areas. In the healthcare sector, organizations should consider offering higher bonuses for shift work, especially for night shifts, which can be a significant burden for nurses balancing family life and caregiving responsibilities. Additionally, improving management and leadership quality is crucial in both sectors, as effective leadership positively affects retention.

Nonetheless, given the fundamental differences in how education and healthcare are organized, it should be considered that the implementation of specific interventions may differ and face unique challenges within each sector. What they have in common is that wage policies are generally tied to general wage policies in the public sector. Deviating from these wage policies, consequently has implications for wages in the entire public sector and can have substantial consequences for public spending. This is the case for both education and healthcare despite the fact that healthcare funding is often more segregated from other public spending categories than education funding. In the Dutch healthcare sector, many organizations are failing to meet production agreements with health insurers due to staff shortages. As a result, these healthcare organizations may face budget cuts. However, many of them have little to no financial reserves for additional investments, such as wage increases. The budget for wage increases and financial incentives to attract more workers have to be contracted separately with health insurers. The ability to do so is further limited by the macro-budget for health care determined by the government. On the other hand, health insurers are obliged to ensure access to healthcare for their insured population, even if this is restricted by staff shortages. Next to sectoral differences, there are differences across countries in the ease of implementing specific interventions. For example, expanding the scope of practice of (registered) nurses like in the US may not be as straightforward in other countries. The US features a more segmented nursing system with a clear task division among registered nurses, licensed practical nurses, and certified nursing assistants. In the Dutch system, on the other hand, the task division between bachelor-trained nurses and vocational-nurses is less clear.

4.2 Limitations to Interpretation

Intervention categories that are relatively often cited as having positive causal effects on employment might signal that they can indeed be implemented to attract and retain teachers and nurses. At the same time, it is important to discuss the limitations that underlie these results. In particular, the included studies (i) employ different research designs, (ii) focus on either education or healthcare, (iii) consider short-term effects for a single unit – e.g. school or district, and (iv) can contain multiple (in)effective components.

4.2.1 Research Designs

This review only includes studies with research designs that aim to measure causal impacts of interventions on labor supply. The retrieved studies employ different designs as shown in Table 7. Only 22 percent of the studies employ (clustered) RCTs. Van Klaveren and De Wolf (2013) suggest that this design provides the strongest evidence for causal inference as units of observation are randomly assigned to treatment and control groups. The remaining studies use quasi-experimental designs in which the assignment to treatment or control follows from features in naturally occurring data. The validity of the assumptions underlying these models are crucial to interpret the evidence as causal. As discussed by Imbens and Wooldridge (2009), the regression discontinuity design arguably gives strong evidence of causal effects as it relies on few and easily verifiable assumptions. Other models rely much more heavily on independence assumptions that are not easily verified in the data such that the likelihood of bias increases. Table 7 shows that studies that employ RCTs, RDs, but also DiDs, least often document positive effects on employment of interventions that are (mostly) designed to do so. As described above, these studies are also arguably least susceptible to bias and therefore may reveal more accurate intervention effects. If we only consider RCTs and RDs, then *Financial incentives*, *Coping* and *Professional Development* are the intervention categories with the greatest share of employment enhancing effects. This coincides with the main results mentioned above.

4.2.2 Limited Scope and Follow-up Research

Many of the included studies contain causal evidence with a distinct focus on one outcome measure, potentially contaminated control groups, partial equilibria, and the short run. First, studies often focus solely on entry or exits where 80 percent of the studies focus on the latter. As many interventions aim to increase the attractiveness of a job or profession – e.g. less stress, greater income, better professional

Table 7 Percentage of studies with employment effects per research design

Research designs	No effect on entry or retention	Increase on entry or retention	Decrease in entry or retention	N
Difference-in-differences	50%	43%	7%	30
Fixed-effects regression	17%	66%	17%	12
Instrumental variable	25%	50%	25%	4
Propensity score matching	33%	67%	0%	3
Randomized controlled trial	56%	44%	0%	18
Regression discontinuity	22%	22%	56%	18
Total	46%	43%	11%	85

Summarized overview of main effects on employment depending on the research design utilized by the studies

outlooks – one could expect both retention *and* entries to increase. In contrast, policy implementations may simultaneously decrease entries and exits due to the higher costs, for example. Hence, the focus on one outcome measure – exit or entry – does not signify the effect on total employment. Moreover, only one retrieved study (Askildsen et al., 2003), focuses on the number of hours worked as an outcome measure. Increasing our understanding of how workers can be stimulated to work more hours may help address shortages as both the education and healthcare sector are characterized by a large share of part-time workers. Future research may thus include a battery of outcome measures such that the total effect on employment can be observed. Exploring the effects of a wage effect on both the *intensive* and *extensive* margin, for example, is of the essence as it is not ex ante clear how teachers' decision on working hours will respond to a wage increase. Insights on total employment effects can also be elicited by focusing on teacher preferences directly. For example, vignette analyses can reveal how teachers or nurses hypothetically respond to different interventions and thereby inform policy research about the anticipated effects of interventions and provide guidance on which interventions to implement and evaluate.

Second, by definition of a clean design to identify causal effects, the control group must mimic what would have happened in the absence of an intervention. Therefore, teachers or nurses nested in control units – e.g. schools or hospitals – that are in the proximity of treated units are not perfect control units as they are potentially affected by the treatment due to spillovers. For example, a wage increase in hospitals in municipality A may draw nurses from hospitals in adjacent municipality B. Clean identification of causal effects may thus be hampered as the total treatment effect now includes both the change in outcome in the treatment group and the change in the control group. Similarly, in certain studies (e.g. DeCesare et al., 2017) it is unclear whether or to what extent the control group also incorporates elements of the intervention that are implemented in the treatment group. For example, some schools potentially already incorporate elements of early-career supervision such that lower bounds of causal effects of induction programs are identified. Clearly, prospective research should be clear and transparent in explaining how the control group mimics the situation that *would have happened* without the implementation of the respective intervention.

Third, most studies only document partial equilibria effects. Typically, nurse and staff shortages are a large-scale problem whilst interventions are often aimed at pulling away workers from one area or sector and redirecting them to another. As such, it is unclear whether the shortage in total has increased or decreased. An interesting avenue for follow-up research is thus to consider not only the benefits for the treated group, but to also consider the potential costs that are incurred by the untreated group due to an intervention. The increased availability of administration or registration data provides an opportunity to test these *general* equilibrium effects and to assess to what extent policies may induce negative externalities or “waterbed effects”.

Fourth, many studies document short-term effects where it is unclear how policies will affect employment in the long-run. On the one hand, employment effects may be short-lived. One-time wage increases or issuing of financial bonuses may only attract more workers in the short run, for example. On the other hand, policies that implement systematic changes may yield long-term increases in employment. School turnaround policies, for example, may increase turnover in the short run, yet have positive effects on entry and retention in the long-run due to better working conditions. A straightforward suggestion for future research is thus to investigate the long run effects of (quasi-) experiments for which the short-run outcomes have already been evaluated. More generally, the setup of experiments to investigate employment effects in teaching and nursing can be designed in such a way that follow-up outcomes are recorded and both short- and long run effects are evaluated.

Fifth, given that we qualitatively synthesized the available evidence on potentially effective interventions, our study does not address the potential presence of publication bias. Publication bias can be addressed by means of a meta-analysis, which ideally estimates the impact of comparable interventions on comparable outcome measures. A meta-analysis will also enable researchers to provide better insight into how effect sizes differ across intervention categories. Ideally, this type of analysis is combined with a cost-effectiveness analysis to evaluate the economic efficiency of different interventions.

A final shortcoming of our study is that we mostly limited our discussion to increasing the supply of teachers and nurses. However, good quality education and healthcare does not only depend on the size of the workforce, but is also determined by the quality of the workforce. This especially holds for teachers who offer education to multiple students at the same time. In fact, decreasing class sizes – and thus increasing the number of teachers – sometimes leads to no or only modest improvements in student achievement (see e.g., Hoxby, 2000; Woessmann & West, 2006), while investments in teacher quality might generate more favorable learning outcomes (see e.g., Hanushek, 2011). Hence, the debate on teacher and staff shortages should not be limited to increasing the size of the workforce, but also its quality. We posit that above-mentioned shortcomings are fruitful avenues for future research and should be addressed explicitly in the evaluation of policy effectiveness.

Appendix 1

Search 1.

Web of Science (Core Collection) Session Results (17 January 2022).

Search	Query	Items found
S1	TS = (teach* OR nurs*) AND (shortage OR turnover OR mobility OR attrition OR transition OR retention OR retain* OR productivity) AND (police* OR interven*) AND (effect* OR impact OR evaluat* OR causal OR experiment*)	8202

After applying database filters for journal articles as document type, publication dates between 2010 and 2022, English language, and high-income countries, we obtained 4892 abstracts to screen. After the screening process outlined in Sect. 2, we retrieved 26 papers with a research design that allows for causal inference, out of which only 6 studies were on nurses. Furthermore, a number of causal studies we are aware of were not in this list. To increase the number of causal studies on both teachers and nurses, we conducted an additional search in three databases (ERIC, CINAHL and WoS) with the help of a medical information specialist.

Search 2.

ERIC (Ebsco) Session Results (20 May 2022).

Search	Query	Items found
S3	S1 AND S2	835
S2	TI ("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasi-experiment*") OR AB ("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasiexperiment*") OR SU ("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasiexperiment*")	131,831

Search	Query	Items found
S1	((DE "Occupational Mobility" OR DE "Teacher Transfer" OR DE "Labor Turnover" OR DE "Career Change" OR DE "Career Choice" OR DE "Career Planning" OR DE "Occupational Aspiration") AND ("teacher*" OR "nurs*")) OR DE "Teacher Shortage" OR TI (("teacher*" OR "nurs*") N3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring")) OR AB (("teacher*" OR "nurs*") N3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring")) OR SU (("teacher*" OR "nurs*") N3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring"))	23,142

CINAHL (Ebsco) Session Results (20 May 2022).

Search	Query	Items found
S3	S1 AND S2	1172
S2	TI ("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasi-experiment*") OR AB ("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasiexperiment*") OR SU ("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasiexperiment*")	549,495

Search	Query	Items found
S1	((MH "Career Mobility + ") OR (MH "Career Planning and Development") OR (MH "Personnel Turnover") OR (MH "Personnel Shortage + ")) AND ("teacher*" OR "nurs*") OR TI(("teacher*" OR "nurs*") N3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring")) OR AB(("teacher*" OR "nurs*") N3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring")) OR SU(("teacher*" OR "nurs*") N3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring"))	42,613

Web of Science (Core Collection) Session Results (20 May 2022).

Search	Query	Items found
#3	#1 AND #2	1212
#2	TS=("random* control* trial*" OR "random* clinical trial*" OR "RCT*" OR "instrumental variable*" OR "difference-in-difference*" OR "dif-in-dif" OR "regression discontinuit*" OR "fixed effect*" OR "control group*" OR "intervention group*" OR "treatment group*" OR "propensity score*" OR "score match*" OR "panel data" OR "longitudinal data" OR "random effect*" OR "causal*" OR "experiment*" OR "quasiexperiment*")	6,566,218
#1	TS=("teacher*" OR "nurs*") NEAR/3 ("shortage*" OR "turnover*" OR "turn-over*" OR "mobilit*" OR "attrition*" OR "transition*" OR "retention*" OR "retain*" OR "recruit*" OR "persist*" OR "supply" OR "leave" OR "hire" OR "hiring"))	16,127

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Declarations

Conflict of interest The authors declare that there are no competing interests.

Ethical approval Please notice that an adaptation of a part of this study has been published in a Flemish non-scientific policy journal (*Over.Werk*) in the Dutch language:

“Stolp, T., Somers, M., Fleck, L., Groot, W., & van Merode–Maastricht, F. (2023). De effectiviteit van financiële prikkels om lerarentekorten aan te pakken. Een systematisch literatuuroverzicht. *Over. Werk*, 37.” We deem the submission to *De Economist* justifiable because:

1. *De Economist* addresses a scientific audience whereas *Over.Werk* is intended mainly for an audience of policy makers.
2. *De Economist* addresses an international audience whereas *Over.Werk* is intended for an audience (mainly) from Belgium and The Netherlands.
3. The written language in *De Economist* is in English whereas the written language in *Over.Werk* is Dutch.
4. The submitted manuscript to *De Economist* has a much wider scope than the publication in *Over.Werk*. In particular, this submission covers *all* interventions to reduce staff shortages. Alternatively, the publication in *Over.Werk* is specifically geared towards *financial incentives* as a way to reduce staff shortages. As such, the aforementioned publication focusses more narrowly on financial incentives and is not simply a partial translation of this submission

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