

Is this an epic innovation? Electronic health record implementation and healthcare workers' work characteristics and autonomous motivation – a before-and-after study

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Abstract

Background Technological innovation in healthcare is often assumed to contribute to the quality of care. However, the question how technology implementation impacts healthcare workers has received little empirical attention. This study investigates the consequences of Electronic Health Record (EHR) implementation for healthcare workers' work motivation.

The consequences of EHR implementation for healthcare workers' autonomous work motivation are hypothesized to be mediated by changes in perceived work characteristics (job autonomy and interdependence). Additionally, a moderating effect of profession on the relationship between EHR implementation and work characteristics is explored.

Methods A quantitative uncontrolled before-and-after study was performed among employees from a large university medical centre in the Netherlands. Data were analysed following the component approach for testing a first stage moderated mediation model, using Generalized Estimating Equations (GEE).

Results A total of 456 healthcare workers (75 physicians, 154 nurses, 145 allied healthcare professionals, and 82 administrative workers) finished both the baseline and the follow-up survey. After EHR implementation, job autonomy decreased, whereas interdependence increased. In line with our hypothesis, job autonomy was positively associated with autonomous motivation. Interdependence showed the same association, which we did not anticipate. Autonomous motivation was stable over the course of EHR implementation. This study did not provide support for a moderating effect of profession, meaning that no differences were observed between the various professions regarding the changes in their experienced job autonomy and interdependence after EHR implementation.

Conclusions Our study showed that healthcare professionals' work characteristics, but not their autonomous motivation, are affected by EHR implementation, and that these experiences were relatively similar for physicians, nurses, allied healthcare professionals. The stability of healthcare workers' autonomous motivation may be explained by the opposite effects of decreased job autonomy and increased interdependence, and the EHR being in line with healthcare workers' values. The changes in job autonomy and interdependence may have consequences beyond motivation, for example by affecting clinical decision making, proactive behaviour, and the quality of teamwork. These potential consequences of EHR implementation warrant further research.

Background

Healthcare faces constant changes due to technological and medical innovations that aim to improve the quality, efficiency or safety of care [1, 2]. The factors contributing to or hindering the implementation of these innovations have been widely investigated, showing – among other things – that the involvement of staff is essential for the success of these innovations [1, 3, 4]. However, one largely under-investigated

area within and outside healthcare is how these innovations impact workers in terms of their work motivation and the way they experience their work [2, 3, 5–7].

The lack of knowledge about the consequences of innovations for healthcare workers is problematic because work motivation and work characteristics are important predictors of performance and wellbeing [8, 9]. More specifically, autonomous forms of motivation among healthcare workers have been associated with higher quality and safety of care, and with lower susceptibility for burnout [10, 11]. Furthermore, healthcare workers' motivation and characteristics of the work environment affect the extent to which healthcare workers proactively learn from positive and adverse incidents and speak up in the face of threats to patient safety, which is important for continuous quality improvement and organizational learning within the complex healthcare setting [12, 13].

The aim of the present study, therefore, is to examine the impact of the implementation of technology on the work characteristics and autonomous motivation of healthcare workers. The possible changes in work characteristics and motivation are investigated in an uncontrolled before-and-after study within the context of organizational change. This organizational change entails an innovation that many healthcare institutions have implemented during the past decades, namely an *electronic health record* (EHR).

The theoretical framework of this study is depicted in Fig. 1. In short, we are curious about the relationship between EHR implementation and healthcare workers' autonomous work motivation, and we anticipate that two work characteristics, namely, job autonomy and interdependence, mediate this relationship. In addition, we explore the moderating effect of profession on the relationship between EHR implementation and work characteristics.

With this study, we aim to make three contributions to the literature. First, we aim to shed light on the 'complex array of forces' [15 p24] that affect the success of technologies, thereby answering calls for research on the impact of technology implementation in the work setting [6, 14]. According to Parker and Grote [15], the forces that affect technology success entail work characteristics, and individual, technological and organizational factors. We aim to contribute to this literature by investigating the effects of EHR implementation on healthcare workers' work characteristics and their subsequent work motivation. Second, going beyond existing work on technology implementation, which tends to focus on specific groups of workers [5, 14, 15], this study involves four major groups of healthcare workers (physicians, nurses, allied healthcare professionals, and administrative workers) and explores the differences in their reactions to EHR implementation. Finally, we aim to contribute to the literature on the self-determination theory of motivation by following three recommendations to advance the theory, namely, (a) we investigate the relationships between concrete work characteristics and motivation, (b) we do this in the context of technology implementation, and (c) we use a longitudinal (before-and-after) design to do this [6].

Electronic health records

An EHR is a longitudinal digital record of a patient's health information, such as demographical information, medical history, diagnoses, medications, radiology images, laboratory data, healthcare workers' notes and other clinically relevant information. Although an EHR could be considered the digital equivalent of the classic paper or computer-based health record of a patient, it differs from the traditional record in important ways. An EHR is an *integrated* record, containing information from all healthcare workers involved in a patient's care. This information can be accessed instantly and securely by authorized users [16, 17]. Compared to the traditional records they replace, EHRs increase the availability of information, and support information exchange among health care providers. Additionally, EHRs are often equipped with tools to improve healthcare practice by stimulating healthcare workers' adherence to guidelines and organizational protocols (for example, through reminders and by blocking access or orders where necessary). Therefore, EHRs have many anticipated functional benefits, such as improved quality, safety, and cost-effectiveness of care, and enhanced clinical decision making [16–18].

In order to harvest these potential functional benefits, clinical and operational changes need to be made [19]. For example, EHRs change and standardize workflows and documentation requirements, shift tasks from one healthcare worker to another, and affect communication during the provision of patient care [16–21]. Thus, implementation of an EHR changes the nature of work for healthcare workers. These changes alter the work characteristics of healthcare workers, which in turn is likely to affect their work motivation [2].

Work motivation

Work motivation is defined as 'a set of energetic forces that originate both within as well as beyond an individual's being, to initiate work-related behaviour, and to determine its form, direction, intensity, and duration' [23 p11]. One widely used theory of motivation and the way it is affected by the (work) environment is the self-determination theory (SDT) [8]. The SDT describes a continuum of various types of motivation. Simply put, this continuum ranges from *not wanting* to do something (amotivation), through *having to* do something (controlled or extrinsic motivation), to *wanting* to do something (autonomous or intrinsic motivation) to [8]. This study focuses on autonomous motivation, as research has shown that an engaged and autonomously motivated healthcare workforce is essential for the delivery of high-quality care [10, 23, 24].

Autonomous work motivation refers to motivation out of reasons stemming from within the employee him- or herself; i.e., it stems from a sense of self-determination. Autonomously motivated employees want to put effort into their work because they find their work enjoyable or interesting (intrinsic motivation), or because the work is in line with their values, personal goals and identity (identified regulation) [8, 25].

Further, the SDT states that motivation becomes more autonomous when workers experience satisfaction of their basic psychological needs for autonomy (the need to feel in control), relatedness (the need to maintain positive relationships with others), and competence (the need to experience a sense of mastery) [8, 9]. Importantly, the SDT states that characteristics of the work hold the potential to boost or thwart

autonomous motivation, as they affect the extent to which workers experience satisfaction of their basic psychological needs [8, 9, 26]. Specifically, autonomous motivation is thought to be boosted (vs. thwarted) by work characteristics that support (vs. undermine) employees' sense of autonomy, competence, and relatedness. Based on this premise, we anticipate that EHR-related changes in work characteristics will be associated with changes in workers' autonomous motivation [6, 14].

Work characteristics

Work characteristics, here understood as 'the attributes of the task, job, and social and organizational environment' [30 p1333], and their consequences for motivation and performance, have been widely investigated [2, 27]. A vast body of research shows that work characteristics, such as job autonomy, clarity about roles, task variety, feedback, team climate, and leadership style, can significantly boost or weaken motivation [2, 27, 28].

Because EHR implementation requires several clinical and operational changes [5, 19], healthcare workers' work characteristics are likely to be affected by these changes. Subsequently, we will argue that two work characteristics are particularly relevant in case of EHR implementation, namely; *job autonomy* and *interdependence*, which are likely to affect satisfaction of the basic psychological needs for autonomy and relatedness. We do not consider the need for competence [8], as we anticipate that feelings of competence are particularly likely to be affected by the quality of training, IT skills and teething troubles of the system [7, 19, 29], which are not the main focus of this study.

Job autonomy. Job autonomy refers to the extent to which the job allows workers freedom to plan their work, to make decisions and to choose work methods [27, 28]. Although the behaviour of healthcare workers is partly directed by protocols and regulations, autonomy is ingrained in the jobs of workers who provide direct patient care (e.g., physicians, nurses or allied healthcare professionals), since their jobs require them to act upon their specific professional knowledge and skills [30, 31]. A high level of autonomy allows flexibility, which supports healthcare workers' clinical decision making [32]. In addition to supporting the provision of patient care, job autonomy gives healthcare workers a sense of volition at work. This feeling of being self-controlled satisfies their need for autonomy, which contributes to their autonomous motivation [8, 26].

An EHR is likely to affect healthcare workers' job autonomy, as it enables external control over their clinical decision making and scheduling of work [14, 33]. For example, EHRs often have standardized methods of record keeping, specific built-in workflows that are based on standardized work processes, and may be equipped with decision support tools that guide healthcare workers' decision-making process for routine tasks. Furthermore, formal control of work procedures may be increased by defining role-based access and role-based permissions (e.g., only physicians rather than other staff members are allowed to order specific tests or medications), and adherence to workflows may be stimulated through reminders or other actions of the system, thereby reducing the extent to which healthcare workers can freely organize their own work tasks [7, 19]. Previous research on EHR implementation found that primary care physicians experienced less autonomy after EHR implementation due to work scheduling interference

[33], and nurses participating in a study by Bergey et al. [16 p4] even referred to their hospital's EHR as 'a needy baby that has to be answered every time it cries' to express their workflow-related experiences.

Based on these previous findings, we expect that the introduction of an EHR will decrease healthcare workers' perceptions of job autonomy (*Hypothesis 1a*). Since perceptions of job autonomy should be positively related to autonomous motivation (*Hypothesis 1b*), we anticipate that, taken together, EHR implementation is negatively related to healthcare workers' autonomous motivation through (i.e., mediated by) their perceived job autonomy (*Hypothesis 1c*).

Interdependence. The second work characteristic that we consider in this study is interdependence, which refers to the 'connectedness' people experience in their job: the extent to which workers depend on others and others depend on them to complete their work [27]. In most healthcare settings, workers are highly dependent on each other when caring for and treating patients [34]. When jobs are highly interdependent, healthcare workers need to mutually adjust and coordinate their efforts to realize high quality care. Especially when these mutual adjustments require face-to-face interactions, there will be ample opportunities to develop relationships with others, and the extent to which these relationships are positive or negative will affect the fulfilment of the need for relatedness [27, 35].

The introduction of an EHR, however, implies that these mutual adjustments are much more controlled by the digital system; this will be accompanied by the standardization of operating procedures so that work practices of different health care workers become tightly coupled and more interdependent [7, 15, 19, 36]. For example, in the hospital setting, the EHR might require the surgeon to place an order in the system for patient transfer from the operating room to the intensive care unit (ICU). Before EHR implementation, ICU workers could immediately start providing care, whereas after EHR implementation, they have to await the surgeon's order before being able to access the patient record and start providing care. As illustrated by this example, interdependence may lead to production blocking and process losses because employees have to wait for the input of others [37]. In such cases, interdependence may even lead to conflicts [38] that further impair positive interactions [39]. Furthermore, due to EHRs, the need for face-to-face interactions will be lessened [1, 19, 40, 41]. As such, an EHR may decrease the opportunities for employees to develop positive social relationships [27, 42], while high-quality interpersonal relationships are especially important in highly interdependent work settings [43]. Less positive relationships lower the level of satisfaction of the need for relatedness. According to the SDT, this will have a negative influence on autonomous work motivation [8, 9, 26].

Following the arguments above, we hypothesize that the introduction of an EHR will be associated with an increase in healthcare workers' perceptions of interdependence (*Hypothesis 2a*), and that perceptions of interdependence will be negatively related to autonomous motivation (*Hypothesis 2b*). Taken together, we anticipate that EHR implementation is negatively related to healthcare workers' autonomous motivation through (i.e., mediated by) perceived interdependence (*Hypothesis 2c*).

Professional differences

The healthcare workforce in hospitals is diverse, being constituted by workers from various occupational backgrounds, including nurses, physicians, physician assistants, social workers, dieticians, and administrative workers. Physicians, nurses and allied healthcare professionals (HCPs) are highly trained and socialized within their profession [5, 44, 45] and complex (in)formal hierarchies exist amongst these different professions, in which roles and responsibilities depend on one's position in the hierarchy [15, 46]. This diversity might be reflected in people's responses to the implementation of an EHR [5, 14, 46]. The distinct roles and methods of socialization amongst healthcare workers are likely to cause them to value and experience their work context and the EHR differently. For example, physicians traditionally hold a highly autonomous, self-regulating role [33]. It is possible that due to their traditionally high levels of autonomy, they value autonomy more than the other professions, and changes in autonomy may therefore be more salient to them [5, 7].

There is little existing knowledge about professional differences in the consequences of technology implementation to build upon, and roles and hierarchies within healthcare may be affected by digitalization [5, 15, 47]. Therefore, rather than formulating directional hypotheses, this study explores the moderating role of profession on the relationship between EHR implementation and work characteristics. In other words, we will explore whether any differences exist between four professional groups of healthcare workers (nurses, physicians, allied HCPs, and administrative workers) regarding the changes in their levels of autonomy and interdependence after EHR implementation.

Methods

Setting and procedure

The study took place in a large academic medical centre in the Netherlands. The data were collected in two waves: a baseline measure, taking place between September and the 1st of December 2017, and a follow-up measure, conducted between May and September 2018. The implementation of the EHR (Epic) took place at the 2nd of December 2017. The survey was sent to all employees of the academic medical centre who were registered as working with the EHR, and included clinical (e.g., nurses and physicians) as well as non-clinical (e.g., administrative) staff. Employees working with the EHR received an email with an invitation to participate in the survey, which contained a link to an online survey platform (Qualtrics). After giving informed consent, employees completed the measures described below. The survey ended with demographic questions regarding respondents' age, gender, profession, tenure and education. A total of three reminders to participate were sent to non-responders.

Measures

Autonomous work motivation. Autonomous work motivation was measured with the six items constituting the identified and intrinsic motivation subscales from the Multidimensional Work Motivation Scale, which was validated in Dutch [48]. Example items are '*I have fun doing my job*' and '*Putting effort into this job aligns with my personal values*', $\alpha_{\text{baseline}} = .90$; $\alpha_{\text{follow-up}} = .93$).

Work characteristics. Perceptions of job autonomy and interdependence were measured using the Dutch version of the Work Design Questionnaire (WDQ-NL) [27, 49, 50].

Job autonomy was measured in terms of work scheduling and decision-making autonomy (6 items, e.g., *'The job allows me to make a lot of decisions on my own'*, $\alpha_{\text{baseline}} = .91$; $\alpha_{\text{follow-up}} = .93$). Interdependence was measured using six items (e.g., *'My job cannot be done unless others do their work'*, $\alpha_{\text{baseline}} = .86$; $\alpha_{\text{follow-up}} = .85$). All the items mentioned above were answered on a 7-point Likert Scale (1 = *completely disagree* to 7 = *completely agree*).

Statistical analysis

Data were analysed using SPSS for Windows, version 23. Healthcare workers who were not physicians, nurses, allied HCPs or administrative workers were excluded from analysis as this group of healthcare workers (including, among others, students, managers, lab workers, and EHR support workers) was deemed too diverse to draw meaningful conclusions. Participants who did not respond to the motivation scales (the main outcome variable) were considered to have provided incomplete responses and also excluded from analysis. The outcome variable, autonomous motivation, was not normally distributed (with Shapiro-Wilk for baseline $W(454) = .91$, $p < .01$ and for follow-up $W(454) = .87$, $p < .01$). Therefore, Spearman's rho was calculated to determine the correlations between the variables. Preliminary analyses included a non-parametric Kruskal-Wallis test to explore the differences between the professions regarding their levels of autonomous motivation, and for job autonomy and interdependence, an ANOVA was done for this purpose.

The Generalized Estimating Equations (GEE) method was used to test the hypotheses [51]. This approach to estimating the parameters of a generalized linear model, assumes neither a normal distribution nor independent data, which makes it suitable for non-normally distributed data from repeated measurements. Additionally, the GEE method overcomes the issue of incorrect estimation of regression model parameters that may occur when the data consist of repeated measures, as it takes the correlation among responses given by the same participant into account. This requires specification of the correlation structure, which was set to unstructured (meaning that the correlation structure emerges from the data), which is appropriate for a within- and between subjects repeated measures design [51, 52].

The theoretical framework was tested following the 'component' approach, which entails performing joint-significance tests of multiple parameter estimates within the theoretical framework [53, 54]. In this approach, simple mediation is established by following recommendations that build upon the work by Baron and Kenny [55]. It involves the following steps of examining the parameter estimates representing the relationships (1) between the independent variable X (time) and the outcome variable Y (work motivation), (2) between the independent variable X (time) and the mediating variable(s) M (work characteristics), and (3) between M and Y, while controlling for X (i.e., time and work characteristics are simultaneous predictors of motivation). The effect is considered to be mediated (indirect) when the individual coefficients linking X to M and M to Y are both statistically significant (or neither of the 95%

confidence intervals in step 1 and 2 includes zero), and the coefficient of X in step 3 is significant smaller than in step 1. Further, moderated mediation is demonstrated when 4) there is a significant effect of the moderator variable Z (profession) on at least one path in the causal process linking X (time) to Y (motivation) via M (work characteristics), while 5) the remaining unmoderated path is not equal to zero (i.e., the 95% confidence intervals of the parameter estimates that represent the association between work characteristics and motivation do not include zero) [53, 54]. All hypothesis tests presented are two-sided, with $\alpha = .05$ level tests, and 95% confidence intervals are given for each of the parameter estimates. As previous research shows that older employees might respond differently to EHR implementation than younger employees [19], we controlled for age in all regression analyses.

Results

Preliminary analysis

At baseline, the survey was (partially) completed by 2173 out of 9039 healthcare workers (24% response rate), and at follow-up, 898 out of 8859 healthcare workers still working at the same university medical centre (partially) completed the survey (10% response rate). A total of 599 participants completed both the baseline and the follow-up survey, yielding a 27.5% response rate relative to the baseline respondents. Of those, 456 participants belonged to the professional groups of interest, yielding our final sample. The flow diagram of response and attrition is depicted in Fig. 2.

The mean age of the included healthcare workers was 46.36 ($SD = 11.13$); the majority (79.4%) of participants identified as female, 20.0% identified as male and 0.7% identified as 'other' (e.g., non-binary). Of the study participants, 16% were physicians, 34% were nurses, 32% were allied HCPs (e.g., physician assistants or dieticians), and 18% were administrative workers (e.g., medical secretaries or financial administration department employees). The average job tenure of the healthcare workers was 11.81 ($SD = 10.02$) years.

The means, standard deviations and correlations among the variables of interest at baseline and follow-up are given in Table 1, showing that healthcare workers had relatively high autonomous motivation at both times ($M_{baseline} = 6.16$, $M_{follow-up} = 6.15$). The descriptives of the study variables per profession at both measurements are given in Appendix Table 1. There were no differences between the various professions regarding their level of autonomous motivation at baseline ($\chi^2(3) = 1.22$, $p = .75$), nor at follow-up ($\chi^2(3) = 1.21$, $p = .75$). There were some differences between the professions regarding job autonomy ($F_{baseline}(3, 452) = 5.46$, $p < .01$; $F_{follow-up}(3, 450) = 8.50$, $p < .01$), which was lowest at both measurements amongst allied HCPs, compared to physicians, nurses, and administrative personnel. At both measurements, interdependence was highest amongst physicians and administrative workers, compared to nurses and allied HCPs ($F_{baseline}(3, 452) = 9.48$, $p < .01$; $F_{follow-up}(3, 452) = 6.95$, $p < .01$).

Table 1
Means (M), standard deviations (SD) and Spearman's correlations of the measures of this study (n = 456).

	M	SD	1	2	3	4	5	6	7
Baseline									
1. Age	46.36	11.13	-						
2. Autonomous motivation	6.16	0.68	.02	-					
3. Job autonomy	4.86	1.18	.10*	.23**	-				
4. Interdependence	4.66	1.10	-.09*	.11*	.00	-			
Follow-up									
5. Autonomous motivation	6.15	0.79	.06	.61**	.16**	-.03	-		
6. Job autonomy	4.78	1.28	.11*	.21**	.74**	-.02	.23**	-	
7. Interdependence	4.88	1.08	-.11*	.06	-.11*	.59**	.05	-.01	-

* $p < .05$; ** $p < .01$ (2-tailed). Variables 2 to 7 were measured on a 7-point Likert scale.

Attrition analysis

At both measurements, the sample of healthcare workers participating in the study was representative of the occupational distribution of personnel working with the EHR in the academic medical centre. Women were slightly overrepresented in the final sample of health care workers who participated in both measurement moments, compared to the percentage of women working in the academic medical centre (79.4% ($n = 456$) versus 69.8% ($n = 12735$), $\chi^2(1) = 19.37$, $p < .01$). No differences were found in the occupational distribution when comparing the group of respondents (i.e., the physicians, nurses, allied HCPs, and administrative workers, who completed both measurement moments ($N = 456$) with the baseline-only-respondents ($N = 854$). An independent samples t-test showed that the respondents were somewhat older than the baseline-only-respondents ($M = 46.36$ versus $M = 44.02$, $t(1308) = 3.6$, $p < .01$). Although age might affect EHR responses, the consequences of self-selection were probably limited as no differences were found between the two groups (respondents versus baseline-only-respondents) with regard to any of the variables of interest.

Hypothesis testing

In accordance with the component approach, we report on the relationships between time and each work characteristic, on the relationship between the work characteristics and autonomous motivation, and on

the mediating effect of the work characteristic on the relationship between time and autonomous motivation. The results of the GEE analyses are presented in Table 2.

Job autonomy. As predicted by Hypotheses 1a and 1b, perceptions of job autonomy decreased after EHR implementation ($\beta = -0.09, p = .04$) and perceived autonomy was positively associated with autonomous motivation ($\beta = 0.12, p < .01$). However, the mediation test showed that motivation neither decreased after EHR implementation ($\beta = -0.01, p = .74$) in step 1, nor in step 3 of the mediation analysis. Therefore, not all the conditions that demonstrate mediation were met and we have to conclude that the data do not support Hypothesis 1c.

Interdependence. Furthermore, as predicted by Hypothesis 2a, healthcare workers' perceptions of interdependence increased after EHR implementation ($\beta = 0.24, p < .01$). In contrast to Hypothesis 2b, which anticipated a negative effect of interdependence on autonomous motivation, our results actually showed a *positive* effect of interdependence on autonomous motivation ($\beta = 0.07, p < .01$). However, the conditions to confirm a mediation effect as formulated in Hypothesis 2c were not met, because autonomous motivation remained relatively stable over the course of time ($\beta = -0.01, p = .74$) in both step 1 and in step 3 of the mediation analysis.

Profession. The interaction between time and profession was not statistically significant for autonomy ($\chi^2(3, N = 452) = 1.53, p = .67$), nor for interdependence ($\chi^2(3, N = 452) = 3.75, p = .29$), thereby failing to support a moderating effect of profession.

Table 2
Parameter estimates with confidence intervals (CIs) of the GEE regression analyses.

		Work characteristics				Autonomous motivation	
		Job autonomy		Interdependence			
Step		β	95% CI	β	95% CI	β	95% CI
1	Time					-.01	-.07 -.05
	Age					.01	-.01 -.01
	Intercept					6.10**	5.85- 6.35
2	Time	-.09*	-.17 \boxtimes -.01	.24**	.14 \boxtimes .33		
	Age	.01 ⁺	.00 \boxtimes .02	-.01*	-.02 \boxtimes -.01		
	Intercept	4.46**	4.04 \boxtimes 4.88	5.09**	4.74 \boxtimes 5.44		
3	Time					-.01	-.08 \boxtimes .05
	Job autonomy					.12**	.07 - .17
	Interdependence					.07**	.02 - .11
	Age					.01	-.01 -.01
	Intercept					5.23**	4.78- 5.68
4	Time	-.10	-.30 \boxtimes .09	.06	-.12 \boxtimes .24		
	Nurses	-.02	-.30 \boxtimes .26	-.71**	-.97 \boxtimes -.46		
	Allied HCPs	-.33*	-.65 \boxtimes -.01	-.65**	-.94 \boxtimes -.36		
	Administrators	.19	-.16 \boxtimes .54	-.25	-.58 \boxtimes .07		
	Time \times Nurses	.03	-.20 \boxtimes .26	.20 ⁺	-.03 \boxtimes .43		

		Work characteristics				Autonomous motivation	
		Job autonomy		Interdependence			
	Time×Allied HCPs	-.04	-.29 ☒ .22	.21	-.05 ☒ .47		
	Time×Administrators	.11	-.15 ☒ .37	.21	-.11 ☒ .53		
	Age	.01 ⁺	.01 ☒ .02	.01 ^{**}	-.02 ☒ -.01		
	Intercept	4.55 ^{**}	4.07 ☒ 5.02	5.63 ^{**}	5.22 ☒ 6.04		
5	Time					.01	-.16 ☒ .18
	Job autonomy					.13 ^{**}	.08 ☒ .17
	Interdependence					.08 ^{**}	.03 ☒ .13
	Nurses					.11	-.07 ☒ .29
	Allied HCPs					.10	-.08 ☒ .28
	Administrators					-.08	-.29 ☒ .14
	Time×Nurses					-.04	-.23 ☒ .15
	Time×Allied HCPs					.01	-.19 ☒ .21
	Time×Administrators					-.07	-.28 ☒ .15
	Age					.00	-.01 ☒ .01
	Intercept					5.08 ^{**}	4.60 ☒ 5.56
⁺ <i>p</i> < .10, [*] <i>p</i> < .05, ^{**} <i>p</i> < .01. The reference category for time was baseline and for profession was physicians. <i>N</i> = 456.							

Discussion

In this study, we examined the consequences of technology implementation, in this case EHR implementation, for healthcare workers' autonomous motivation. We tested these consequences in a before-and-after field study among healthcare workers in an academic hospital, assessing participants' perceived job characteristics both prior to and after the implementation of an EHR. Our aims for this study were threefold.

The consequences of EHR implementation. Our first aim was to shed light on the impact of technology implementation in the work setting, by investigating its consequences for autonomous motivation, and by addressing the mediating effects of job autonomy and interdependence. In line with previous research, we found that respondents' levels of perceived job autonomy dropped slightly after EHR implementation, while job autonomy in turn was positively associated with autonomous motivation [15, 19, 26, 33].

As expected, perceptions of interdependence increased after EHR implementation; however, unexpectedly, perceived interdependence was positively (rather than negatively) associated with autonomous motivation. In our hypothesis we reasoned that interdependence after EHR implementation would diminish feelings of relatedness, as the system would lessen face-to-face contact, thereby potentially obstructing collaboration and interfering with positive interactions [1, 19, 40, 41]. Possibly, the clinical work still allowed for sufficient (informal face-to-face) contact to contribute to positive relationships at work. It could also be that the EHR facilitated rather than thwarted the coordination of interdependent tasks, thereby supporting collaboration and feelings of relatedness, which could explain the positive association between increased interdependence and autonomous motivation. Another explanation is that increased interdependence might have affected motivation in other ways, such as through an increased sense of responsibility, which contributes to internal work motivation [28]. For example, in a study among police officers, it was found that interdependence in teams of police officers was associated with a higher sense of responsibility for other people's work, which contributed to the motivating potential of their jobs [56]. Likewise, Kuvaas [42] found that task interdependence among public sector employees was positively associated with intrinsic motivation. It appears, then, that the relation between interdependence and autonomous motivation is more complex and multifaceted than we initially hypothesized. Future research could address the dual nature of interdependence more extensively, for example by measuring the quality of relationships or by testing the mediating roles of a sense of responsibility versus a sense of relatedness.

Another unexpected finding was that healthcare workers' autonomous motivation remained stable in the face of EHR implementation, despite a loss of job autonomy and increased interdependence. This can be explained by the fact that the two indirect pathways (i.e., the effects of time through both mediators, one of which was positive, and the other negative) cancelled each other out [57]. More specifically, whereas the loss of autonomy may have decreased healthcare workers' levels of autonomous motivation, interdependence was positively associated with autonomous motivation, and therefore its increase might have led to a boost of autonomous motivation, resulting in a net effect on motivation that approximates zero.

Yet another explanation for the stability of autonomous motivation may be that EHRs have a variety of motivation-relevant effects beside the changes in work characteristics analyzed in the current paper. On the one hand, the EHR supports healthcare workers in achieving their work-related goals and values, but on the other hand the administrative burden resulting from EHR may impair autonomous motivation. More specifically, the instrumental value of the EHR is likely to contribute to healthcare workers' sense of identified regulation. Throughout the literature, it has been observed that healthcare workers perceive the EHR as a vehicle to achieve quality and safety in patient care, which is one of their core values and thereby supports their autonomous motivation [19, 26, 58]. Thus, healthcare workers generally endorse the idea of an EHR, which raises the question whether EHR implementation should be associated with an *increase* in autonomous motivation. However, as EHR systems were originally developed to support billing, administration and regulation of healthcare [59], healthcare workers often experience struggles with the system and frustrations about usability issues and a lack of compatibility between the EHRs and their clinical work [19, 29, 44]. The struggles and frustrations that follow from working with these systems in clinical practice might negatively affect healthcare workers' intrinsic motivation, and might counteract the positive consequences of EHR implementation on autonomous motivation through an increased sense of identified regulation. We therefore recommend investigating whether the development of an EHR that is primarily designed to support patient care holds the potential to boost healthcare workers' autonomous motivation.

Professional differences in responses to EHR implementation. The second aim of our study was to contribute to the literature by exploring the moderating role of profession in healthcare workers' reactions to EHR implementation. We found that the change over time was the same for all healthcare workers, despite initial differences between the professions regarding their levels of perceived job autonomy and interdependence. This might indicate that the implementation of an EHR affected the work characteristics of all healthcare workers more or less equally. Another explanation might be related to the use of self-reported measures of job autonomy and interdependence, as the degree to which people value job autonomy and interdependence might be reflected in the extent to which people perceive these job characteristics to be present in the work environment. In other words, a physician and a member of administrative staff reporting a 'moderately high' level of autonomy may not report the same objective levels of autonomy, because their expectations and beliefs about what constitutes 'high' or 'low' autonomy in their respective jobs may differ. Therefore, the self-reported measures might have not been sensitive enough to distinguish between need valuation and experience. However, it could also be argued that perceived job characteristics are particularly important when it comes to predicting motivational outcomes: having an objectively high level of autonomy will not be motivating if it is not perceived as such, a topic which has been debated within SDT [60, 61]. Future research could further explore this issue by applying qualitative methods or using, where possible, more objective or implicit measures of work characteristics.

Conclusions

In conclusion, implementation of an EHR was associated with a drop in perceived autonomy and an increase in perceived interdependence. Although this did not carry over into a change in autonomous motivation, these findings do warrant further research into the impact of technology implementation on the quality of teamwork in hospitals and the relationships between work characteristics and basic psychological need satisfaction, e.g., between interdependence and experienced relatedness, specifically. One key implication of this study is that there should be attention for healthcare workers' job autonomy and the quality of their teamwork in the face of technology implementation, as these work characteristics not only affect their work motivation, but are also essential for the delivery of high-quality and safe patient care.

More generally, although it is impossible to predict future developments, it seems highly likely that the digitalization of healthcare will continue for a long time. In other words, healthcare workers will continuously be confronted with changes in the way they do their jobs and the way their work (as well as the way they work together) is organized. Research on how this affects them, their perceptions of their work, and their wellbeing, therefore remains crucial.

Abbreviations

EHR: Electronic Health Record

HCP: healthcare professional

SDT: self-determination theory

Declarations

Ethics approval and consent to participate The study protocol for both waves of data collection was approved by the Ethics Committee of the Department of Psychology, University of Groningen. Before giving their informed consent to participate in the study, participants were presented with the global aims of the study, were guaranteed that their responses would be kept confidentially, and were informed that they could retract themselves from the study at any given time.

Consent for publication Not applicable.

Competing interests None declared.

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Authors' contributions ER and JP initiated the study. GV, JP and ER were involved with the data collection. GV and ER were involved with the data preparation and analysis and prepared the manuscript, with

feedback from EH, EM, and GW. All authors were involved in the design of the study and have read and approved the final manuscript.

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Figures

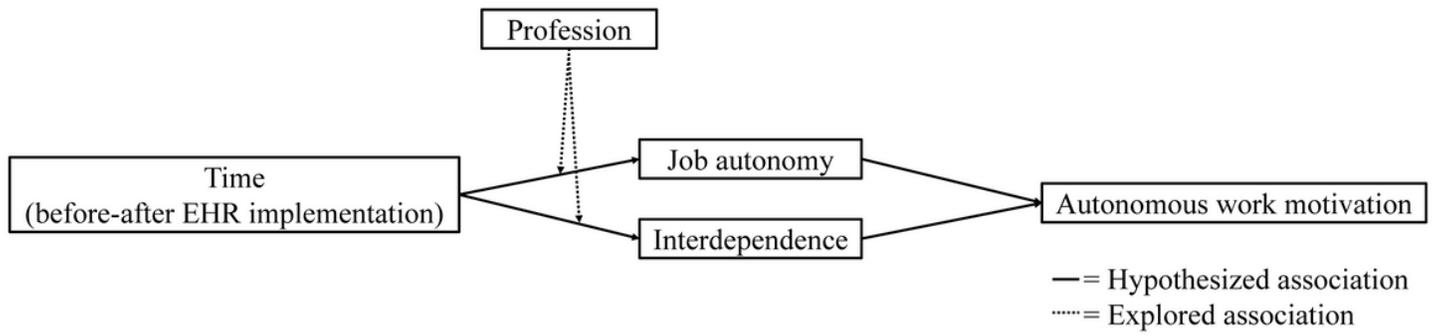


Figure 1

Theoretical framework of this study.

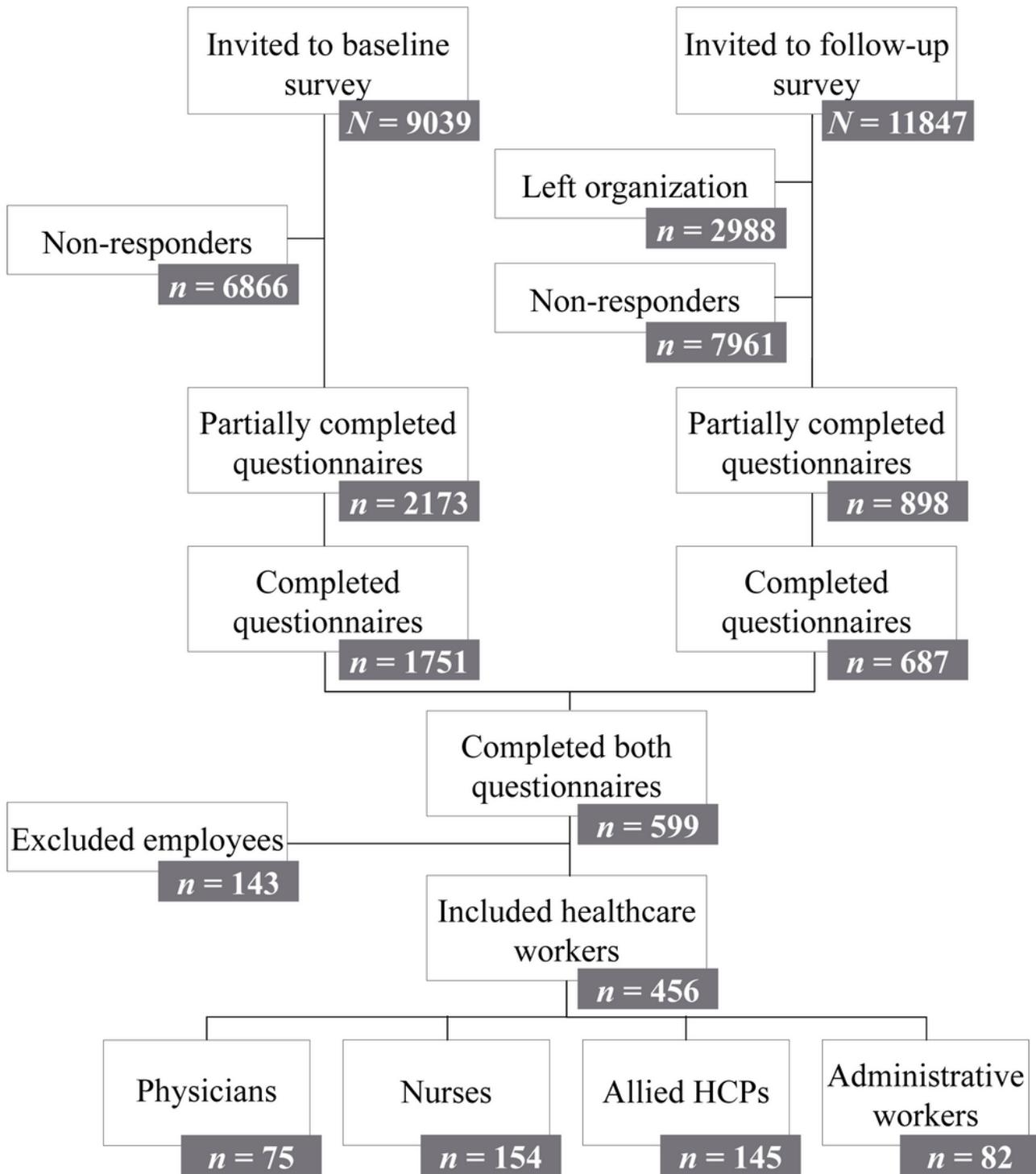


Figure 2

Flowchart of response and attrition

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