

New Technologies And Workloads Of Health Care Professionals

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Abstract

Multiple case studies were carried out in Brazil and the Netherlands from 2003 to 2009, with the objective of analyzing the influence of high-technologies on the workloads of health care professionals. The data was obtained and analyzed through a triangulation of methods. ATLAS.ti, software program for qualitative data analysis, was used for data analysis. The interviews, observation notes, and documents studied from each case were initially bundled in three Hermeneutic Units (HUs), with the purpose of identifying elements that may decrease or increase workloads. Afterwards, the three HU were merged into a single new HU that included all research data. Our findings were that the great majority of those interviewed perceived that high technologies decrease workloads. First, because new equipment is more ergonomic, which reduces physical strain, and it also provides more precise data about patients. Second, because new technologies in the organization of work contribute to a more collaborative and satisfactory job environment. Stronger collaboration and greater satisfaction improve the safety and quality of health care, thus reducing workloads. Innovation increases workloads: in the initial use of new technologies, when it occurs in the contexts of cost reductions, non-participative managerial models and in poor working conditions, or when there is a lack of training to work with new technologies. In conclusion, high technologies may increase or decrease workloads depending on the context, which is especially influenced by work conditions, management models, and institutional values.

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Keywords

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Introduction

The health sector has been influenced by technological innovations. This process has brought significant changes in therapeutic procedures and changes in the organization of work with consequences for the sector in terms of costs as well as for the workforce (Toussaint & Gerard, 2012; Lorenzetti, Trindade, Pires, & Ramos, 2012; Rotenberg, Griep, Fischer, Fonseca, & Landsbergis, 2009; Pires, 2008).

Considering technology in a sociological sense, it “embraces all forms of productive technique” and “is not synonymous with machinery in some popular accounts” (Abercrombie, Hill, & Turner, 2006, p. 357). Furthermore, “the term includes the physical organization of production; that is, the way in which production hardware is arranged in the work place,” including “the division of labor and organization of work that is built into or required for efficient operation by the production technique” (ibid.).

There is a strong relationship between technology and workloads of those who perform work. Workloads, as formulated by Seligman-Silva (1994) and by Laurell & Noriega (1989), can be understood as elements that synthesize the mediation between work and worker’s burnout. Workloads do not act

alone; rather, they act in combination with other workloads that determine the conditions under which workers are confronted with the global logic of the work process.

Considering this scenario, it is important to understand how technological innovations contribute to the reduction of daily workloads, allowing workers to perform their jobs in a more integrated way, with less physical effort and more satisfaction. On the other hand, it is also essential to comprehend how new technologies may increase workloads, resulting in dissatisfaction, strain and work-related illness.

We were able to find several studies about technological innovations in the health sector (Lorenzetti, 2013; Toussaint & Gerard, 2012; Snooks et al., 2008; Lehoux, Williams-Jones, Miller, Urbach, & Tailliez, 2008). We also found studies regarding the health of workers in the health care sector (Trindade & Pires, 2013; Chung et al., 2012; Trindade, Lautert, Beck, Amestoy, & Pires, 2010; Chan, 2009; Spetz, 2008; Hallin & Danielson, 2007). However, publications that address the implications of technological innovation on the workloads of health professionals are quite rare (Pires et al., 2012a).

In light of these initial findings, we conducted our research in two countries, the Netherlands and Brazil, at a total of five hospitals in order to analyze the influence of technological innovations on the workloads of health professionals. The study was based on sociological theory, particularly the Marxist perspective on the work process (Marx, 1982), the Claus Offe study about the dynamics of the service sector (Offe, 1991), and the theory of Laurell & Noriega (1989) on workers' health and workloads.

Research Design And Method

This is a multi-case study with a qualitative approach, performed in different political institutional scenarios (two countries, three cities, and five hospitals), with the general objective of understanding a complex phenomenon in greater depth. The cases were chosen intentionally, including reference institutions and sectors that utilize technological innovations.

Case 1 was conducted in a recently inaugurated shock room (SR) located in the emergency department (ED) of a top hospital in the Netherlands. All the equipment was new, high-tech and ergonomic – easy to handle with little physical effort. The new environment and work organization were reorganized to enable better access to diagnostic tests and to allow the easy exchange of information between doctors and nurses, and between different medical specialists. Both professionals and equipment were available in the same location or they moved to the SR when needed. CT scanning was available in an adjacent room and moved by rail into the SR as necessary. Experts were added to the team as needed.

Case 2 involved two intensive care units (ICUs) located in a city in southern Brazil, one in a public hospital (PH) and another in a private hospital (PrH). The ICUs were chosen because they were permanently affected by the technological innovations, especially by high-tech devices.

Case 3 included two interdisciplinary teams, one responsible for elderly care (geriatric team, GT) and another for palliative care (PC) for cancer patients (both located in public hospitals in a southern Brazilian capital). The interdisciplinary teams were chosen because they work under the interdisciplinary perspective, typifying an innovation of the non-material organizations of work.

In choosing the participants, the following inclusion criteria were applied: health professionals were directly involved with new technologies for patient care; health teams included diverse health professions; and all professionals agreed to participate in the research.

Data were collected over a period of seven years, from 2003 to 2009, obtained and analyzed using the triangulation process. Data was collected through documentary study, observation and semi-structured interviews.

The documentary study and systematic observation provided information about institutional structures, work conditions, forms of work organization, management models, and available technological innovations (material and non-material). The semi-structured interviews were aimed at capturing the perception of health care professionals regarding the impact of the new technologies on their workloads.

In total, for all cases, 63 health care professionals of differing professions were interviewed. Case 1: eleven health professionals from the ED in the Dutch hospital (14.8% of the entire ED team). Case 2: 33 professionals from health care teams working in the ICUs of two southern Brazilian city hospitals (17 from the private hospital and 16 from the public hospital, corresponding to 40.0% and 35.45% of the ICU teams, respectively). Case 3: 14 professionals from the PC team (56% of the team) and five health professionals from the GT team (82% of the team). The sample in each case was considered sufficient according to the criterion of data saturation.

To ensure the reliability of the data, the interviews were taped and the observations recorded in a field notebook.

For data analysis, ATLAS.ti 7.0 software was used to determine elements that increase and decrease workloads. The software-aided triangulation and was used to bundle the interviews, field notes and analyzed documents. Each case was structured as a Hermeneutic Unit (HU) including the set of documents from each case. Afterwards, these HUs were merged into a single HU with all of the survey data, which were analyzed according to two macrocategories, i.e. – the influence of new technologies on increasing and decreasing workloads, while considering the theoretical perspective chosen for this study.

In presenting the results, the participants' statements used in this manuscript are identified by the name of the professional category (P - physician, N - nurse, AN - auxiliary nurse, PT - physiotherapist), followed by the identification of institutions and teams (H - Dutch hospital; PC - palliative care; GT - geriatric team; PH and PrH - public hospital and private hospital).

All recommended ethical precepts regarding research involving human subjects were respected. The project was approved by the Dutch institution and by the Human Research Ethics Committee of the Federal University of Santa Catarina, protocol no. 326/07.

Results

Technological Innovation Reduces Workloads

Considering the data from each case, the most significant motives for decrease workloads were organized in tables according to four sub-categories: high-tech equipment and new work organization improve health care; interdisciplinary perspective reduces workloads; skills to work with the new technologies and technical support reduce workloads; less repetitive work decreases workloads.

High-tech Equipment And New Work Organization Improve Health Care

Computerized tomography scanners (CT scans), ventilators, infusion pumps and electronic medical records contribute to providing safer, more efficient and better quality care, decreasing cognitive, emotional and physical workloads. They provide more reliable and more effective data and increase safety in medication administration and the monitoring of vital functions.

Electronic health records (EHRs) integrate all patient-related information, thus increasing the safety and providing easy access to patient data for all health care staff from any sector of the hospital.

New equipment in combination with changes in the work environment and new work organization saves time, promotes interdisciplinary exchange among health professionals and provides more confidence in care while decreasing physical and emotional workloads. Health workers feel more satisfied and less stressed because they are providing the best-known treatment to patients, resulting in more favorable outcomes. They become more efficient at saving lives.

Codes	Quotations
New equipment decrease physical and emotional workloads	The ventilators are getting more and more sophisticated with several ventilation modes already programmed.... This makes work easier and more pleasurable. (P8/PrH) The cardiac monitoring system is complete.... At the end of the shift, all one has to do is copy the summary. There is more time left for us to do other things, such as to give a bed bath, monitor diuresis, and administer medication. This is excellent. (AN3/PH) In the Dutch hospital, case 1, the great majority of the professionals were really positive about the utilization of new technologies in their jobs. They were also confident that the new machinery is safe and works well. (Observation Note)
New equipment and work organizations make work easier and improve quality of care	It is better than before. In the first place because logistically it is easier, everybody is in the same place. Secondly, and most importantly, it is because it is much better for patients. We save time, so much time. Previously a patient could come in and we would put her/him on the table for X-rays ... and to another table to be transported to the first floor for CT scanning.... So, these procedures wasted time, caused problems and were dangerous when patients were unstable. (P5/H)
Computer-based medical records im-	The information is in the computer, using a patient data management system. We already have this in the ICU and we are also going to have this in the operating room (OR) and in

prove care quality	SR. So they can all communicate. All professionals will take notes in the same form on the computer. At the moment, it is still separate but we are trying to put it together. (P5/H) A simple measure such as computer information [from the medical record] increases efficiency. (P2/PC)
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Table 1: High-tech equipment and new work organization improve health care

Interdisciplinary Perspective Reduces Workloads

The interdisciplinary perspective decreases workloads and improves job satisfaction. Each professional realizes the importance of their fellow colleagues' knowledge and that more comprehensive participation positively impacts the health care process. Satisfaction and motivation linked to this form of work organization reduces workloads. In addition, the interdisciplinary exchanges enable the safer delivery of care.

Codes	Quotations
Interdisciplinary work increases job satisfaction	When I started to work here, I was surprised because I had never seen a group like that. This is described in books, in the classroom. Even though they did not know me, they were already pleased to have a physiotherapist on the team. (...) it is a very good team to work with. (...) professionally, it is quite rewarding. (PT/PC)
Interdisciplinary work improve quality of care	I can get to know my patients better (...). I have contact with dieticians, physicians, and with nursing. So I think that the best benefit of one of these teams is for the patient himself. (PT/PC) The whole team is involved (...) while the physician examines the patient, the nurse or the nursing technician monitors the other [patients]. We work together (...). So it is not just one person who controls, it is not just the doctor that evaluates. (...) the whole group is accountable (...). It is a positive experience. (P3/PrH)

Table 2: Interdisciplinary perspective decreases workloads and improves care for patients

Skills To Work With New Technologies And Technical Support Reduce Workloads

Education and training contributes to increased security in handling the new equipment, thus reducing workloads. Support from technical areas to resolve daily problems also contributes to a reduction in workloads.

Codes	Quotations
Training reduces workloads	The companies send their people to teach (...) nurses and doctors how to use the equipment. When [the hospital] buys a piece of new equipment somebody comes in and stays for a week or two to teach everybody how to work with the machinery. (N5/H)
Support from technical areas reduces workloads	The Technical Support Department helps to keep the equipment working and our Technical Department is very good. (...) Depending on the costs involved, we may have a contract with a company or we may have internal technicians. (N5/H)

Table 3: Skills to work with new technologies and technical support decrease workloads

Less Repetitive Work Decreases Workloads

In case 1, the professionals mentioned that the work in the shock room puts them in a situation of permanent challenge, due to the diversification of activities. The contact with different health care professionals and the unpredictability of what might occur every day at work is challenging. These characteristics of work have been identified as motivators for reducing workload.

Code	Quotations
Diversification of activities decreases workloads	I like my work because it is really diversified. I work with trauma, I do normal anesthesiology and I manage my own Department. I also do management and research. It is a nice combination of things. To me there isn't anything I really like more than anything else. Every day is different. (P5/H) I like the diversity of the activities. All the specialties are found here: neurology, pediatrics, everything. I like this diversity a lot. I like the small things. I like to care for people who have hurt their finger in a door and also the big things, such as major trauma. There is always a diversity of activities. (N4/H)

Table 4:

Technological Innovation Increases Workloads

The main causes/sources of increased workloads are shown in Table 5 through Table 7. In case 1, the great majority of the participants mentioned that, in the beginning, working with the new technology increased physical and emotional workloads due to the need to adapt to a new situation, even when the workers were previously trained to work with new equipment and new environment. The relationship between training/education and workloads was significant in all cases.

Codes	Quotations
Initial work with innovations increases workloads	Now we have a new ventilator (...) and people have to work with it and no one knows how it works (...). I was there this morning and everybody asked: Where is the cable, where do I have to put it? But it is always the same with new stuff. So it takes a lot of extra time. (N3/H)
Lack of skills increases workloads	I had no training (...). I think that being trained would have been nice, especially for someone new to the place, who does not know how to operate things, the routines, and everything else. (N6/PrH) When a new employee arrives, what he/she ends up absorbing is what he/she sees. And that is not always good. We do not offer them an introduction to palliative care and how we work [under the interdisciplinary perspective](...). So, this new employee might get lost along the way because he/she might not understand. (P1/ PC)

Table 5:

In all cases, professionals mentioned that when technological innovation is not accompanied by an adequate number of staff, there may be an increase of workloads. This is possible in situations where the same numbers of workers are needed to accomplish more activities in a greater quantity and diversity than before the implementation of innovations. Workloads may also increase when the number of workers is insufficient to meet the demands, and when the same number of workers must perform more activities in a shorter period of time.

Deficits in working conditions (salary, working hours, physical area, work instruments, number of staff and support areas) increase workloads.

In the Dutch hospital, the working conditions were not mentioned as increasing workloads. In contrast, in all Brazilian cases the work conditions were significant in increasing workloads. Workers reported poor working conditions related to factors such as equipment deficits, personnel deficits, problems in the effectiveness of supporting sectors, difficulties in the referral and counter-referral relationships between primary health care and hospitals, low wages and long working hours.

Codes	Quotations
Innovation oriented towards cost reduction increases workloads	This Monday we had a trauma patient. We did the conventional X-rays and CT scanning and we reported in 14 minutes. This would have been impossible under the old conditions. We used to take one and a half hours even when we were working quickly. Now we might spend half of that time. I think I will have to treat more patients because we are quicker than before. We have to control the number of patients who come by ambulance. If we care for the same number of patients we need less health care professionals, but if we receive more patients we will need the same number of personnel, maybe even more.... If you look only at the trauma patients they might decrease, but if you look at all the things I have to do they might increase. (P4/H)
Poor working conditions increase workloads	We have already had situations where we had ventilators sent out to be repaired and we had to provide mechanical ventilation. This is very frustrating, because you know that it is unacceptable to abuse a patient like that for 6 to 12 hours. So, this causes a very high level of stress.... If you send a ventilator out to be fixed, for something simple that does not require a part coming from another place, when it is sent out by morning, you expect that at least in the afternoon it will be back in the department. And quite often, people prioritize other things as more important, because they do not understand the importance of the equipment. This is very stressful. (N8/PH)

Table 6: Cost-cutting technological innovations and poor working conditions increase workloads

In all cases we found that non-participation in the decision-making process has negative consequences for workers and for work outcomes.

Code	Quotations
Non-participative management model increases workloads	When we want something...it depends on who is there and if he/she thinks it is also important, if there is money. So, they decide. We have a lot of computers and we need more monitors – but they decided we need computers, so they buy computers and no monitors. (N4/H) This year (...) we arrived in January and faced changes in patient appointments (...). Nobody ever came to us to ask us about it (...). I do not think we participate, not even at the high level of decision. Whenever there is new management, we go there, discuss the project [of the interdisciplinary work] and nothing happens. So, this led us to a lack of enthusiasm. (N 4/GT) It is humanly impossible to follow decision-making that has to do with you when you do not know anything about it. (...) there was no administrative decision to involve the entire group in the process. (PT1/PC)

Table 7: Management model and workloads

Discussion

The research showed that technological innovations have implications on workloads and are perceived as mostly positive in reducing the workloads of health care professionals. It also showed that innovations can increase or decrease workloads depending on multiple factors, such as: the political and institutional context; at the outset of working with new technologies; the conditions for the introduction of innova-

tions as well as the training of the professionals to work with the new equipment; working conditions; the participation of the professionals in the institutional and team decision-making process; the perception of the subjects regarding the utility of the innovations for the performance of their work; and the political/economic basis for the innovation process.

Innovations Contribute To The Reduction Of Workloads

New equipment managed by the healthcare professionals in the studied institutions is more ergonomic, more lightweight and easier to handle, reducing physical efforts and risk of injury and illness. Similar findings were published in a literature review regarding nursing workloads and patient safety in an ICU (Carayon & Gürses, 2005).

High-tech equipment provides more reliable data with greater speed and accuracy, helping professionals in diagnoses and patient care. High-tech equipment integrates data sets that were formerly provided separately by different groups of medical professionals. Thus integrated in the machine, patient data can be used by diverse professionals to monitor vital functions and to support the decision-making process. Similarly, the electronic health records (EHR) organize and provide comprehensive patient information, enabling access to all patient data by different professionals in different sectors and contributing to the achievement of safer and better quality care. The implementation of the EHR has been studied by a number of authors, who have pointed out the cost effectiveness and the improvements in patient outcomes (George & Bernstein, 2009; Baron, Fabens, Schiffman, & Wolf, 2005).

Instruments that facilitate work and contribute to better outcomes decrease physical, cognitive and emotional workloads. However, multiple factors influence the way in which the work is done; among these factors are: working conditions; the care model and values guiding teams and institutional managers; economic objectives expected to be met with the implementation of the innovation, as well as the subjective aspects involved in the decisions of the subjects who perform the work (Schwartz & Durive, 2010; Dejours, Abdoucheli, & Jayet, 1994; Offe, 1991).

An interdisciplinary approach and participative processes improve job satisfaction and quality of care. The diversification of activities and coping with new challenges stimulates continuous learning and contributes to increasing satisfaction at work.

Interdisciplinary teamwork in health care can be regarded as a technological innovation in the area of non-material work organizations. It considers the needs of patients in their multiple dimensions and does away with the traditional biomedical model of work organization in health care. Participatory and collaborative practices improve relationships between team members, making them more confident and more understanding of their demands, difficulties and differences (Trindade & Pires, 2013; Matos, Pires, & Gelbcke, 2012; Scherer & Pires, 2011).

The diversification of activities and the contact with several types of health care professionals is a constant challenge leading to a less repetitive work. Facing challenges, stimulating creativity and eliminating senseless routines and repetitive work is mentioned in the literature as less alienating and more satisfying, helping to reduce workloads (Dejours, 2009; Ellenbecker, Byleckie, & Samia, 2008; Fuentes et al., 2007; Marx, 1982).

Technological Innovations Increase Workloads

The main causes for increased workloads were: the initial period of working with new technologies and deficits in training and education to work with the process of innovation; implementing innovations mostly aimed at reducing costs; and contexts of non-participatory management and of poor working conditions.

The introduction of a technological innovation implies changing flows and processes in health care practice. In the initial phase, these changes increase workloads. The negative effects on the workloads occur because workers must be trained to handle the new equipment or must learn to work in a different way. At first, the workers need to use both the “new” and the “old” way of performing tasks, increasing the volume of their work; at the same time, they need to manage and adapt to the new technology (Baron et al., 2005; Lee, 2006).

The professionals need to adapt themselves to a new organization of institutional space and they need training to use new machines and equipment. A behavioral and cognitive change is demanded of them; for example, to learn about computers, to understand how a new machine works and how the new organization functions.

Non-participation in decision-making processes – not having control over the changes nor influence on institutional decisions – causes a feeling of impotence. The level of workers’ preparation for change, including education or training and involvement in the changing process, can decrease the cognitive demands made of them. Workloads during the introduction phase for new technology are greater when the change process is accompanied by a lack of training and deficits in working conditions.

Certain complex situations involving the daily work in different units require immediate decision-making and involve risks to patient safety, such as in the ED and ICU. When using an unfamiliar technology, professionals sometimes believe that they may be involving the patients in a high-risk situation. The relationship between them, mediated by technology, without the necessary knowledge to act safely, causes anguish, emotional suffering and fear, which is approached in Christophe Dejours’s studies on the relationship between job insecurity and psychological distress (Dejours et al., 1994).

Non-participatory management models, in which the needs and interests of the workers are neither heard nor acknowledged, interfere negatively with the results of the work and generate dissatisfaction

which, in turn, increases workloads, especially emotional ones (Trindade & Pires, 2013; Bosi, Pontes, & Vasconcelos, 2010).

Working conditions, including tools and equipment of adequate quantity and quality, commensurate salaries, reasonable working hours and adequate staffing, have an effect on workers' relationship with technological innovations. Inadequate working conditions increase workloads (Trindade & Pires, 2013; Pires et al., 2012b; Ellenbecker et al., 2008; Carayon & Gürses, 2005). When the use of high-tech equipment and the organizational changes are not accompanied by an adequate number of staff, higher workloads may occur. For example, when the same numbers of workers are required to perform a greater number of activities, as well as several different activities, and/or when these workers are asked to perform more tasks in a shorter period of time, there may be an increase in both physical and emotional workloads.

In today's society, under the capitalist system, one of the most important motivations for the implementation of change at work is to improve productivity, i.e. the search for better results at lower costs, which is also common in the service sector. These findings are similar to those of Claus Offe (1991) in his analysis of the dynamics in the service sector. Offe mentions that several strategies may be used to increase productivity: technological changes, including new equipment and/or new forms of work organization; cost reduction within the work force, and others.

Conclusion

The research revealed that technological innovations have implications for workloads and can increase or decrease them depending on multiple factors.

The workloads are lower when the innovations contribute to reducing cognitive and physical efforts, as well as when they contribute to reducing emotional demands for better outcomes. Non-material technological innovations involving interdisciplinary work and participative management also contribute to reducing workloads, especially the cognitive and emotional ones.

Working with innovations can increase workloads in the context of non-participatory management and when the model is oriented predominantly to reduce costs. Furthermore, it also increases in environments with poor working conditions.

Finally, considering the design of this research, other studies conducted in randomly selected institutions may find different results, predominated by negative or positive implications in relation to workloads, depending on the institutional context of the innovation.

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