

## The opinions of radiographers, nuclear medicine technologists and radiation therapists regarding technology in health care: a qualitative study

Sil Aarts, PhD, Forra Cornelis, MSc, Yke Zevenboom, BSc, Patrick Brokken, BSc, Nicole van de Griend, BSc, Miriam Spoorenberg, BSc, Wendy ten Bokum, BSc, & Eveline Wouters, PhD

Fontys University of Applied Sciences, School of Allied Health Professions, Chair of Health, Innovations & Technology (HIT), Eindhoven, The Netherlands

### Keywords

Assistive technology, health care professionals, health care technology, nuclear medicine technologists, radiation therapists, radiographers, technology

### Correspondence

Sil Aarts, Fontys University of Applied Sciences, School of Allied Health Professions, Chair of Health, Innovations & Technology (HIT), Dominee Theodor Fliednerstraat 2, 5631 BN Eindhoven, The Netherlands.  
Tel: +31 622739813;  
E-mail: s.aarts@fontys.nl

### Funding Information

No funding information provided.

Received: 8 March 2016; Revised: 22 November 2016; Accepted: 25 November 2016

*J Med Radiat Sci* 64 (2017) 3–9

doi: 10.1002/jmrs.207

### Abstract

**Introduction:** New technology is continuously introduced in health care. The aim of this study was (1) to collect the opinions and experiences of radiographers, nuclear medicine technologists and radiation therapists regarding the technology they use in their profession and (2) to acquire their views regarding the role of technology in their future practice. **Methods:** Participants were recruited from five departments in five hospitals in The Netherlands. All radiographers, nuclear medicine therapists and radiation therapists who were working in these departments were invited to participate ( $n = 252$ ). The following topics were discussed: technology in daily work, training in using technology and the role of technology in future practice. The recorded interviews were transcribed verbatim and analysed using open and axial coding. **Results:** A total of 52 participants (57.7% radiographer) were included, 19 men and 33 women (age range: 20–63). Four major themes emerged: (1) technology as an indispensable factor, (2) engagement, support and training in using technology, (3) transitions in work and (4) the radiographer of the future. All participants not only value technological developments to perform their occupations, but also aspects such as documentation and physical support. When asked about the future of their profession, contradictory answers were provided; while some expect less autonomy, others believe they will get more autonomy in their work. **Conclusion:** Technology plays a major role in all three occupations. All participants believe that technology should be in the best interests of patients. Being involved in the implementation of new technology is of utmost importance; courses and training, facilitated by the managers of the departments, should play a major role. Only when a constant dialogue exists between health care professionals and their managers, in which they discuss their experiences, needs and expectations, technology can be implemented in a safe and effective manner. This, in turn, might positively influence quality of care.

### Introduction

It is often suggested that technology might be one of the solutions to meet the growing need for health care in the future. Advanced technologies are developed constantly, leading to various new and enhanced diagnostic and therapeutic options. Advances in health care technology do not only encompass technologies necessary to diagnose or treat patients, but also include 'assistive

technologies' such as eHealth, electronic health records and e-learning modules regarding health. All these technological developments impact various aspects of care, including the organisation of care, the communication between health care professionals and the communication between health care professionals and their patients.<sup>1,2</sup> Systems such as PACS (Picture Archiving and Communication System) and HIS (Hospital Information System) are examples.

Technological developments are continuously implemented in health care. However, research shows that new technology is not always positively perceived by health professionals.<sup>3,4</sup> For example, the occurrence of problems with power supply and lack of knowledge can make health professionals sceptical about the use of new technology.<sup>4,5</sup> Furthermore, research indicates that in order for a technological application to be adequately implemented, health care professionals should feel competent to use the technology.<sup>3</sup>

The speed at which technological developments are introduced is increasing; especially people working in technology-driven professions are constantly confronted with technological innovations. It is therefore of utmost importance to collect the views and experiences of health professionals regarding technology. By doing so, health departments' managers can anticipate on the needs and desires of these professionals. To date, research focused on the considerations of health care professionals regarding technology is scarce.<sup>5</sup> The studies that examine the opinions and views of health care professionals were restricted to specific technologies such as eHealth<sup>6</sup> and the use of personal health record systems<sup>7</sup> and never focused on radiographers, nuclear medicine technologists and radiation therapists (in Europe defined as 'radiographers'<sup>8</sup>). People who work in these areas of health care have a profound technological profession. However, it is currently unclear how these health care professionals experience the technology they use in their profession, and maybe more importantly, the constant development of this technology. The purpose of this study was twofold. The first aim of the study was to gain insight into the opinions and experiences of radiographers, nuclear medicine technologists and radiation therapists regarding the technology they currently use in their profession. The second aim focused on their ideas about the role technology might play in their professional future. The results of this study can aid hospitals in supporting and improving the introduction and implementation of (new) technology in health care.

## Method

A qualitative research design was applied using semi-structured, in-depth interviews. Hence, the aim of this study is not to find evidence for a hypothesis or a theory, but to provide a basis for new theories or concepts.

## Participants

Participants were recruited from five departments in five hospitals in different parts of The Netherlands. In order to gain a broad perspective on the subject, all

radiographers, nuclear medicine therapists and radiation therapists were invited to participate (for clarity, the term 'radiographers' will be used throughout this article to address these three occupations) and were given an information letter ( $n = 252$ ). This letter stated the aim of the study and provided detailed information regarding the content and duration of the interview. Radiographers who were interested in participation could contact the researcher if they required more information or could contact their department manager in order to schedule an interview. All interviews were conducted during a normal working hours. The manager of the departments arranged that the participants did not have to work at the time the interview took place.

## Data collection

All interviews were conducted between February and May 2015. Before starting the interview, participants were asked if they had any questions regarding the information letter they received. If so, these questions were answered. Information regarding the aim and procedure of the study was also given verbally by the researcher. After the participant had signed the informed consent, an audio recorder was turned on and the interview was started. All interviews were coded before analysing the data, thereby ensuring anonymity. All interviews were conducted in Dutch and lasted about 1 h. The interviews were conducted by five researchers (YZ, NvdG, PB, MS, WtB). An interview guide was developed based on the available literature.<sup>3,5,9</sup> The interview guide ensured that the same set of topics (and questions) was covered in all the interviews, namely (1) the role of technology in daily practice, (2) assistance regarding the use of technology and (3) the role of technology in their professional future. Participation was voluntary. The study was conducted in accordance with the ethics policy of all five health departments and of the Fontys University Ethical Committee.

## Data analysis

Data collection and data analysis occurred concurrently;<sup>10</sup> after every interview the audio recording was transcribed verbatim. Every participant received a summary of the interview for verification (member check<sup>10</sup>). If a participant had any additional comments, they were incorporated in the results. Every transcript was analysed to identify relevant fragments. All key fragments were summarised in a code that reflected the condensed meaning. The researchers discussed the initial coding and consulted the senior researchers in (bi)weekly meetings. During these meetings, the codes were, again, discussed and clustered or renamed if necessary. Afterwards, all

codes were clustered based on similarity and grouped into themes; the interpretation of the main themes were discussed with all (senior) researchers. Saturation (no additional themes arose) was reached. Because of the amount of useful quotations, not every interview provided a quotation for the Results section. However, every quotation used in the Results section came from a different interview (e.g. a different participant). Results from individual departments were pooled, yielding themes applicable for all radiographers. The quotes mentioned in the Results section of this article were translated from Dutch to English.

## Results

A total of 52 participants were interviewed (20.6% of all radiographers working in these five departments,  $N = 252$ ), 19 men and 33 women were included. The majority of participants was working as a radiographer ( $n = 30$ ). The age range was large in all three occupations (see Table 1).

Four major themes emerged: (1) technology as indispensable factor, (2) engagement, support and training in (the usage of) technology, (3) transitions in work and (4) the future of the radiographer.

### Technology as indispensable factor

All radiographers mentioned that technology is a key feature; not only in their work but also in life itself. Moreover, they expect that the influence of technology on their day-to-day activities will only expand in the upcoming decades.

*'There is a lot of technology in this work [...] without technology this profession would not even exist'.*

**Table 1.** Characteristics of participants ( $n = 52$ ).<sup>1</sup>

Occupation	Number of participants (% of total)	Male (% per occupation)	Mean age in years (range)	Mean work experience in years (range)
Radiographer	30 (57.7%)	15 (50%)	37 (23–63)	16 (0.5–40)
Nuclear medicine technologist	12 (23.1%)	2 (16.7%)	32 (25–58)	11 (0.5–35)
Radiation therapist	10 (19.2%)	2 (20%)	43 (20–57)	19 (0.5–32)

<sup>1</sup>Ten radiographers were included per department; in one department 12 participants were included. A total of 252 radiographers were working in these five departments; 52 participants were interviewed (20.6%).

*'We cannot even live without technology'.*

Radiographers state that all technology should be patient-friendly as well as effective. Technology should always improve the quality of care, or at least, not decrease it. According to the participants, the patient should always be the highest priority.

*'The current devices are so sensitive that we can make the same or better pictures with less radiation'.*

*'There is a risk that you hide behind technology and to neglect the human being'.*

*'The patient doesn't know how technology works and not every patient likes the distance created by technology [...] technology should be in favour of the patient, as the patient is more important'.*

*'Sometimes it seems as if we are more technology oriented than patient oriented'.*

Radiographers appreciate that technological developments enable fast and efficient communication. Sharing patient data is now easier than ever. Several participants mentioned that since there are no handwritten requests any more, the risk of making mistakes has decreased.

*'You can use video conference for meetings [...] that is time-efficient'.*

*'We have a group app [...]. If somebody wants to discuss something or is ill, we can swap duties easily. That is a really good thing'.*

*'They (referring to physicians) do not have to come to us. They do not receive a copy. A copy (of a photo) is always inferior to the original'.*

In this regard, radiographers underscore the importance of warranting the privacy of patients, especially, when using system such as PACS.

*'If you are working with varying patient identification codes, you have to be careful to link the pictures to the right codes'.*

*'Even with maximum security, you still hear of things like "hacking". This could be harmful for patients'.*

It was noted that various radiographers expressed feelings of 'helplessness' when using technology; sometimes they feel they rely too much on the technology they use.

*'[...] you get an error message and you cannot do anything anymore'.*

*'If technology works properly, there is no problem whatsoever. But as soon as technology fails, you are in trouble. Before,*

*you were able to solve the problem in a way, but nowadays that is impossible'.*

*'It makes you dependent on a digital system. In case of a power failure you are really in trouble'.*

### **Engagement, support and training in (the usage of) technology**

According to the radiographers, all new technology needs to be introduced and explained to the employees. In addition, opportunity should be given to evaluate the effects and impact of the technology at hand, as experienced by the radiographers.

*'I would always start a pilot to see if the new procedure works. That everyone is informed and that the new technology is tested for a few weeks [...] afterwards people can say what worked and what not regarding the technology'.*

*'I think that the people that have to use the technology frequently should be involved from the start (of the new technology)'.*

The importance of having knowledge regarding the 'underlying processes of a technology', was stressed by all radiographers. They stress the importance of education in order to learn how to use technological devices in a safe, efficient and effective manner.

*'I value education, because I want to know what I am doing. I can press a button easily, but I also want to know what is behind the technology [...] I want to be able to respond to what happens'.*

*'I want to know things. I am going to explore that (the technology) in order to know what I am doing'.*

Participants brought up the need for health departments (i.e. the managers thereof) to play a role in facilitating education related to (the use of) technology.

*'More time and energy should be invested. [...] in that respect the department could be more active'.*

*'The key-users are relatively well educated, but even they do not know all the ins and outs [...]. I think the entire team should have been better educated'.*

*'I see it (education) as an employers' task to facilitate that'.*

### **Transitions in work**

Participants reported that, by using new technological applications, the work rate has increased; more patients

are seen in 1 h than before. According to the radiographers, the current patient flow would have been unworkable in earlier days.

*'Indeed, you do not have to carry patients' medical folders around the hospital anymore, but on the other hand, you see more patients per time unit'.*

*'Work pressure also increases. Of course there are also much more older patients who are less mobile and need more time'.*

Radiographers stated that technological developments have decreased physical strain in employees. The appreciation for technology such as manual controllers and hoists was expressed by multiple radiographers. Especially in light of the fact that employees are still working at an advanced age (i.e. social security is received at age 67 in The Netherlands). Some participants even mentioned a decrease in shoulder problems as a result of this kind of 'supportive technology'.

*'Technology can help in decreasing physical burden [...] so you can keep your own body in mind. You have to keep yourself mobile'.*

*'Working as a radiographer is less of a physical burden than before'.*

According to the radiographers, the constant development of and changes in technology require 'flexible employees'; they are expected to keep up with all these developments and changes.

*'You have to keep an open mind and keep up with the developments'.*

*'It is a lot to learn in a short period'.*

*'For short periods of time it's quiet, and then there is a new development [...] it always come in waves'.*

Radiographers believe that technological developments take over many of their day-to-day activities; they feel that less of their theoretical knowledge is used in performing their profession. Many radiographers experience this as a disadvantage.

*'You trust a computer, but can you be sure that it is correct?'*

*'I think our ready-to-use available knowledge diminishes, but at the same time, we have more skills that can bring us further [...] but in the end I value ready available knowledge as much as skills'.*

*'In the old times, you were 'the computer'. You were more engaged in education and knowledge'.*

*'There is less need for knowledge at hand'.*

Concurrently, keeping up with all available knowledge was mentioned to be increasingly difficult; the pace at which technology develops is just too fast.

*'Nowadays you cannot keep up with everything and know everything [...] you just cannot know everything because so much is changing'.*

*'I think it is difficult to know everything of a technological device. You just cannot know everything anymore'.*

## The radiographer of the future

When asking radiographers about their future work, half of them mentioned to expect to be less autonomous in their work as a result of new technology and 'more rigid protocols'.

*'Perhaps we are going to be exchanged for higher educated IT personnel'.*

*'That our influence will diminish, that is what I fear. That our independence will be non-existent'.*

*'(I hope) that we are not going to be 'push the button' persons, that you don't need to think any more'.*

*'[...] for me patient contact is important. Actually most important. There is always that fear that, at a certain point in time [...], we are not needed anymore'.*

Interestingly, other participants reported to expect a more prominent role in the future, because of the increasing complexity of their work.

*'I think we will work in a different manner [...] we will make more decisions that were previously made by physicians'.*

*'I expect that our role will be bigger. Because more diagnostic examinations are needed. And those diagnostics need to be of a higher quality'.*

## Discussion

The current study aimed at collecting the opinions and experiences of radiographers regarding technology. The results of this study indicate that radiographers perceive technology as a requisite for their daily work; without technology their work is simply not feasible. However, the implementation of new technology should always lead to more efficient and effective care; technology should always be in the patients' best interest. These results are consistent with the opinions expressed by other health care professionals, including physicians and nurses.<sup>3</sup> The participants valued the positive influences of technological developments (e.g. more effective forms of

communication through the use of systems such as PACS) which, according to their opinion, improved the quality of health care. Furthermore, technology used to alleviate the physical strain of the profession, including hoists, were very positively received. Many participants mentioned that these kind of technological devices have made their profession 'physically easier'.

Several barriers for the implementation and correct use of technology were also brought forward. Participants reported that they sometimes feel they rely too much on the technology at hand. When a technological application is not properly working, their daily work is severely hampered.<sup>11</sup> Aspects such as 'crashing computers' or 'power failures' bring about feelings of 'helplessness', which corresponds to the results of previous studies among other health care professionals.<sup>3,4</sup>

Aspects such as responsibility and privacy were discussed extensively in each interview. Participants feel it as their responsibility to use the available technological devices and applications safely, effectively and efficiently. They expressed the need to understand the background and principles of the technology they use, rather than just being 'button pushers'. Furthermore, the lack of knowledge regarding a certain technological device or application was mentioned as a major barrier to successfully implement (new) technology. Radiographers highly value appropriate education, training and the existence of so-called 'key-users' in order to stay up-to-date regarding the latest technological developments. This is also emphasised in the Dutch Covenant of Hospitals entitled 'Safe use of medical technology in hospitals', which states that health care professionals should have sufficient knowledge of and competence in the technology they use.<sup>12</sup> The participants feel that education and training (related to technology usage) should be facilitated by their employers. This is in congruence with the limited available literature that emphasises that health care professionals find it important to be engaged in the technological developments that are implemented.<sup>3,4</sup> It might therefore be recommended that, when a new technology is implemented, radiographers are given the opportunity to attend courses and training in order to safely and effectively use the new technology at hand. Managers of departments can play an important role in facilitating this type of education.

The most remarkable finding, and in the authors' opinion a very novel one, surfaced when radiographers were asked about the future of their occupation. While some radiographers foresee less autonomy for themselves, because they believe much more processes will be automated and standardised, others expect more autonomy in the future because of these technological developments. These results underscore the already

ongoing debate regarding the role of radiographers. In recent years, authors of various studies have proposed role extension for radiographers.<sup>13,14</sup> Examples have demonstrated that role extension may benefit the health care professional as well as their managers and, in turn, might also improve the organisation and quality of care.

The current findings underscore the need for radiographers and their employers to constantly discuss their experiences, ideas and needs. Only when a constant dialogue between health care professionals and their managers exists, new technology can be implemented in health care in a safe and effective manner.

Participants differed in terms of gender, age and work experience. Although generalisability of the results is not strived for in qualitative research, this sample does resemble the Dutch radiographers' population, which increases the transferability of the current results. In addition, the variety of context in which this study was conducted (i.e. in various departments around the nation) should be perceived as a strength of this study.

### Limitations

To our knowledge, this is the first qualitative research within the field of radiography, nuclear medicine and radiation therapy that provides a broad perspective regarding the role of technology. However, the results should be viewed in light of some possible limitations. First, since every interview was conducted by one interviewer, 'subjectivity' could have played a bigger role than when two interviewers were present. However, because of the large sample size (i.e. for a qualitative study) and the frequent meetings to discuss the (analyses of the) interviews, objectiveness was strived for. Second, this study addresses the opinions and experiences regarding technology; the participants were not actually observed when using one or more technological devices or applications. Consequently, it cannot be ruled out that a discrepancy exists between the ideas and opinions people have and their actual behaviour.

### Future work

Since this study was conducted in The Netherlands, the question remains if the obtained results are applicable for radiographers in other parts of the world. Hence, this study should also be conducted in other countries; especially in countries in which the role of radiographers might be different compared to the role of radiographers working in The Netherlands. Future research should especially elaborate on the profession of radiographers in the future. Why do some radiographers expect more autonomy, while others

have an entirely different point of view? And, perhaps most importantly, what impact does this have on the work experience of radiographers, and, on the care their patients receive?

### Conclusion

Radiographers, nuclear medicine technologists and radiation therapists value technological developments not only to perform their occupations, but also regarding other aspects such as documentation, communication and physical support. According to the participants, all technological developments should be in the best interest of the patient. They want to receive more training aimed at increasing knowledge related to technological developments, preferably facilitated by their respective departments (and the managers thereof). When asked about the future of their profession, participants provided contradictory answers; while some expect less autonomy in the future through the use of technology, others believe to get more autonomy.

### Acknowledgement

The authors would like to thank all radiographers who participated. We would also like to thank their managers who made this possible. This study would not have been possible without the participants and their managers.

### Conflict of Interest

The authors declare no conflict of interest.

### References

1. Mozer R, Bradford NK, Caffery LJ, Smith AC. Identifying perceived barriers to videoconferencing by rehabilitation medicine providers. *J Telemed Telecare* 2015; **21**: 479–84.
2. Booth L. The radiographer-patient relationship: Enhancing understanding using a transactional analysis approach. *Radiography* 2008; **14**: 323–31.
3. Nieboer ME, van Hoof J, van Hout AM, Aarts S, Wouters EJM. Professional values, technology and future health care: The view of health care professionals in The Netherlands. *Technol Soc* 2014; **39**: 10–7.
4. Lluch M. Healthcare professionals' organisational barriers to health information technologies-a literature review. *Int J Med Inform* 2011; **80**: 849–62.
5. Mair FS, May C, O'Donnell C, Finch T, Sullivan F, Murray E. Factors that promote or inhibit the implementation of e-health systems: An explanatory systematic review. *Bull World Health Organ* 2012; **90**: 357–64.

6. Das A, Faxvaag A, Svanaes D. The impact of an eHealth portal on health care professionals' interaction with patients: Qualitative study. *J Med Internet Res* 2015; **17**: e267.
7. Nazi KM. The personal health record paradox: Health care professionals' perspectives and the information ecology of personal health record systems in organizational and clinical settings. *J Med Internet Res* 2013; **15**: e70.
8. European Federation of Radiographer Societies. Definition of a radiographer. 2011. (Accessed 01-03-2016, at [http://www.ehrs.eu/publications/see/2011\\_EFRS\\_Definition\\_of\\_a\\_Radiographer?file=298](http://www.ehrs.eu/publications/see/2011_EFRS_Definition_of_a_Radiographer?file=298).)
9. Cowling C. A global overview of the changing roles of radiographers. *Radiography* 2008; **14**: e28–e32.
10. Boeije H. *Analyseren in Kwalitatief Onderzoek*. Boom Onderwijs, Amsterdam, 2005.
11. Gagnon MP, Desmartis M, Labrecque M, et al. Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals. *J Med Syst* 2012; **36**: 241–77.
12. NVZ Vereniging van Ziekenhuizen. *Convenant 'Veilige toepassing van medische technologie in het ziekenhuis'*. Utrecht 2011.
13. Field LJ, Snaith BA. Developing radiographer roles in the context of advanced and consultant practice. *J Med Radiat Sci* 2013; **60**: 11–5.
14. Probst H, Griffiths S, Adams R, Hill C. Burnout in therapy radiographers in the UK. *Br J Radiol* 2012; **85**: e760–5.