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Artificial Intelligence in Radiology—Insights from a Sample of Italian Radiographers' Perspectives

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Abstract

The use of artificial intelligence (AI) in the radiological field has been extensively investigated from the radiologists' perspective. Existing studies have primarily focused on AI's contribution to diagnostic processes and on how its introduction has transformed—and continues to transform—radiologists' professional practice. The perspectives of radiographers remain underrepresented in the literature, despite their central role in image acquisition and their position as the primary "on-the-ground" operators and managers of imaging technologies. The objective of this study was to analyze the perceptions, attitudes, and expectations of Italian radiographers regarding the introduction of AI, and to provide insights to inform professional training and organizational strategies within healthcare systems. A cross-sectional survey study with qualitative enhancement was adopted as the study design. A survey was administered to a convenience sample, comprising 222 respondents. The findings reveal a high level of familiarity with AI in everyday life, accompanied by an almost complete absence of cultural resistance, suggesting a workforce that is both receptive and ready to evolve. Nevertheless, this individual readiness is contrasted with a substantial institutional and operational gap, characterized by the lack of standardized protocols, regulatory uncertainty, and an uneven distribution of technological resources. The effective integration of AI therefore requires a comprehensive and coordinated approach. Educational reform is necessary to integrate AI and radiomics into university curricula and continuing professional development programs, encompassing not only technical competencies but also ethical, deontological and communication skills. Finally, national and European regulatory frameworks must evolve to clearly define radiographers' responsibilities within AI-assisted workflows, to establish robust guidelines for data governance and the management of algorithmic outputs.

Keywords: artificial intelligence; radiology; radiographer; perception; barriers; opportunities

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1. Introduction

Artificial intelligence (AI), defined in ISO/IEC TR 24028:2020 [1] as the capability of an engineered system to learn, process, and apply knowledge and skills, has evolved from

a futuristic concept into an established reality in medicine, due to its rapid and widespread diffusion across all fields of application [2–4] From patient information management to operational support in clinical care, AI is redefining modern healthcare systems. In this context, the radiological sector has recently emerged as a technological pioneer, benefiting significantly from deep learning algorithms for the analysis and interpretation of visual data [5,6].

The advent of AI in radiology demands a rigorous theoretical framework to ensure clinical efficacy, ethical compliance, and scalability. The recent literature emphasizes that the deployment of such systems must be structured around core pillars, including data quality, algorithmic validation, human–AI collaboration, and governance, in alignment with stringent regulations such as the EU AI Act for high-risk medical devices [7]. Key policy documents, such as the white papers from the Canadian and French radiological associations, have already outlined guidelines for a safe transition toward AI-assisted diagnostics. These documents highlight how AI-assisted diagnostics can significantly improve workflow efficiency and patient outcomes [8,9].

The technological landscape is currently extensive, with over 100 commercially available AI products for radiology identified. Nevertheless, the robustness of the supporting scientific evidence varies [10]. Applications range from emergency radiology, where the timely detection of time-dependent pathologies is crucial [11], to pediatric interventional radiology [3] and maxillofacial imaging [12,13]. Despite this broad spectrum, the central issue remains the impact of AI on professional training and practice. The debate has shifted from whether AI will replace radiologists to how the professionals must evolve to work with these systems [14,15].

However, the success of AI implementation depends not only on the technical validity of the algorithms but also on a range of organizational, ethical, and professional factors [16]. In fact, despite the rapid technological advancements, much of the scientific discourse has focused on the potential impact of AI on the medical workforce. Specifically, several studies have sought to capture the "feedback" and sentiments of radiologists regarding the integration of these tools into their clinical routine [17]. International surveys have revealed a complex landscape. While there is a consensus on AI's potential to reduce mundane tasks and improve diagnostic accuracy [15], many radiologists express concerns regarding the "black box" nature of algorithms, the potential decrease in professional autonomy, and the legal implications of diagnostic errors facilitated by AI [14]. Research involving medical residents and senior radiologists has shown that while younger generations are more digitally native and open to AI, there is a shared demand for more robust clinical validation and standardized integration of AI, first and foremost in the use of Picture Archiving and Communication Systems (PACS) [16]. However, this focus on the physician's perspective creates a professional blind spot. While radiologists' feedback is crucial for the interpretative phase, it overlooks the pre-analytical and acquisition phases, where radiographers are the primary actors.

While the literature has extensively explored the perspective of radiologists, a significant knowledge gap persists regarding the viewpoint of radiographers [18]. As the professionals responsible for image acquisition and the primary "on-the-ground" managers of the technology, the radiographers' perspective is essential for understanding the actual integration of AI into the daily workflow. The radiographers' interaction with AI is fundamentally different, since it involves protocol optimization, real-time image quality assessment, and patient dose management [19,20]. To date, the international literature reveals a complex spectrum of perceptions among radiographers, ranging from professional optimism to concerns regarding job displacement and the erosion of human-centric care [21,22]. Despite the proliferation of global studies, a significant geographical disparity

remains evident. Current research is predominantly centered on Anglo-Saxon, Northern European, and Asian populations, leaving the perspectives of Italian radiographers notably underrepresented [23,24]. Given the unique legal framework and educational standards that define the profile of radiographers as healthcare professionals in Italy, and considering the presence of approximately 28,000 radiographers nationwide, their perspectives remain underrepresented in the scientific literature [25–28]. This lack of localized data represents a critical knowledge gap. Understanding the specific attitudes, perceived barriers, and educational needs of Italian professionals is therefore essential to ensure a tailored and successful digital transition within the national healthcare system. This study aimed to investigate Italian radiographers' knowledge, attitudes, perceived preparedness, and expectations regarding AI integration in radiology practice.

2. Materials and Methods

2.1. Study Design and Population

A cross-sectional survey study with qualitative enhancement was conducted to investigate the perceptions and attitudes of radiographers regarding the integration of AI into clinical practice [29,30].

The target population consisted of Italian radiographers registered with the national professional order and authorized to practice under Ministerial Decree 746/1994 [31]. The study was restricted to the Italian national territory (approximately 28,000 professionals) to ensure a homogeneous sample. This choice was dictated by the significant international variations in the professional profile, legal responsibilities, and clinical autonomy of radiographers across different national regulatory frameworks [32].

Inclusion criteria were radiographers registered with Italian national professional board and authorized to practice under Ministerial Decree 746/1994 and working in Italy at the time of survey administration.

Exclusion criteria were incomplete survey and survey with missing or improperly completed informed consent for data processing.

2.2. Survey Development

An extensive literature review was conducted to identify existing validated tools on AI perceptions in radiology.

As no specific instrument was found to be tailored to radiographers' unique professional scope, the research group developed an ad hoc survey in accordance with recommendations for survey design and reporting [33,34].

The survey was first reviewed by a panel of experts (one radiologist; two radiographers, including one representative of the professional order and the other one expert in radiomics; one expert in public health; and one researcher in health professions) to assess content validity, clarity, and items relevance. Following expert review and revision, a pilot test was conducted on a small sample of participants from the target population to assess comprehensibility, feasibility, and completion time.

The survey comprised 15 items organized into five distinct sections (Supplementary Materials S1):

1. Informed Consent: The first section was dedicated to obtaining informed consent for participation in the study and data processing.
2. Sample Characteristics: The second section focused on collecting the respondents' demographic data.
3. AI Knowledge and Usage: The third section investigated the current implementation of AI in the services in which Italian radiography professionals operate.

4. Education and Training on AI: The fourth section was dedicated to collecting data on the level of specific training received or required in relation to AI technologies by Italian radiographers.
5. Perceived impact of AI on the profession: The fifth section assessed the barriers hindering AI adoption and the potential opportunities for Italian radiographers.

2.3. Data Collection and Distribution

The survey was administered digitally using Google Forms to maximize reach and ensure systematic data collection. The distribution was carried out in collaboration with the National and Local Boards of Radiographers and local professional Orders. An introductory e-mail explaining the project's aims, accompanied by a link to the survey, was sent. Data collection took place between 10 November 2025 and 15 March 2026. To encourage participation and ensure honest responses, all data were collected in a strictly anonymous form. Periodic reminders were sent throughout the collection period to improve the response rate. Consent for data management was obtained from each participant in accordance with current European privacy regulations (Regulation (EU) 2016/679, GDPR) and national legislation (Italian Legislative Decree 196/2003, "Personal Data Protection Code").

In accordance with institutional guidelines, the study was exempted from ethics committee approval as the data was collected in strictly anonymized form via a voluntary survey that presented no risk to participants and did not deal with sensitive data. Moreover, this manuscript resulted from an observational study conducted in the field of training and education of Italian radiographers, without any consequences for professional activity.

2.4. Statistical Analysis

Descriptive statistics were used to summarized the characteristics of the study sample and the distribution of responses. Age was reported as mean and standard deviation, whereas categorical variables were described using absolute frequencies and percentages. Open-ended responses regarding barriers to AI implementation and professional opportunities offered by AI were analyzed using an inductive content analysis approach. Responses were independently reviewed, coded, and grouped into recurrent thematic categories by two researchers; discrepancies between them were resolved through discussion within the research team. Similar or overlapping categories were subsequently merged into broader thematic domains. As regards barriers, the final domains included regulatory/legal/privacy/accountability issues, ethical and relational aspects, trust/reliability, resources/infrastructure/time/training, data and standardization, implementation/adoption, occupational risk, error management, environmental impact, and no barriers. For opportunities, the final domains included clinical benefit/quality/safety, workflow/efficiency/support, quality control and data, professional development and role, innovation/technology/research, other/unspecified, and no opportunities. The final categories were then converted into binary thematic variables and summarized as counts and percentages.

As concerns inferential purposes, two main outcomes were considered, namely professional use of AI and self-perceived preparedness to use AI in the workplace. Professional use of AI was recoded as a binary variable contrasting respondents reporting no or minimal use (never/rarely) with those reporting at least occasional use (sometimes/often/daily). Self-perceived preparedness was also analyzed as a binary variable contrasting lower preparedness (unprepared/fairly unprepared/indifferent) with higher preparedness (fairly prepared/prepared). Bivariate associations were explored between these two outcomes and the main survey variables including geographic area, employment sector, work settings, perceived AI application stages within the radiological process, training needs, and

thematic categories derived from open-ended responses on barriers and professional opportunities related to AI. Multiple-response items concerning radiological process stages and training needs were transformed into binary indicators for each response option.

Bivariate associations between survey variables and the two main outcomes were explored using Pearson's chi-square test or Fisher's exact test, as appropriate. A multivariate logistic regression model was additionally explored following the bivariate analyses conducted using Pearson's chi-square test. Since the model did not reveal any additional statistically significant independent associations, nor did it alter the overall interpretation of the results, it was not included in the final presentation of the study findings. All statistical tests were two-tailed, and statistical significance was set at $p < 0.05$. Statistical analyses were conducted using Stata 19 (StataCorp, College Station, TX, USA).

3. Results

3.1. Sample Characteristics

A total of 222 Italian radiographers completed the survey during the study period.

The analyzed sample had a mean age of 43 ± 12.3 years old (range 22–72 years old). Geographic distribution showed a prevalence of professionals operating in northern Italy (n = 124, 55.0%), followed by the south (n = 51, 23.0%) and the center (n = 48, 22.0%) (Figure 1).

Figure 1. Sample in Italy: Distribution of respondents for each Italian region.

Most radiographers reported working in public facilities (n = 170, 76.6%), followed by those working at private centers (n = 38, 17.1%) and freelancers (n = 11, 5.0%). The sample comprised participants active in a wide range of radiological subspecialties. The highest proportion of the sample, approximately two/thirds, was identified in General Radiography (n = 162, 73.0%), followed closely by Computed Tomography (n = 148, 66.7%). A significant portion of the participants also reported working in Magnetic Resonance Imaging (n = 81, 36.5%) and in the Operating Room (n = 67, 30.2%). Specialized modalities showed lower but notable representation, including Breast Imaging (n = 50, 22.5%), Interventional Radiology (n = 47, 21.2%), and Radiotherapy (n = 30, 13.5%). The remaining participants were distributed among Nuclear Medicine (n = 22, 9.9%), Mobile Radiology (n = 17, 7.7%), and Ultrasound (n = 10, 4.5%), while 41 respondents (18.5%) operated in other miscellaneous clinical contexts.

Overall 73.4% of respondents stated using AI at least occasionally. The largest segment (n = 65, 29.3%) engaged with AI "sometimes," while a combined 44.0% used it "often" or "daily," indicating a strong integration of AI into personal routines. Only 8.1% (n = 18) reported having "never" used it (Table 1).

Table 1. Italian Sample characteristics.

Variables		No.	%
Age	Mean 43 ± 12.3 years old		
Geographic area	North	123	55.4
	Center	48	21.6
	South/Islands	51	23.0
Working sector	Public	170	76.6
	Private	38	17.1
	Freelance	11	5.0
	Multiple	3	1.4
Working area	General Radiography	162	73.0
	Mobile Radiology	17	7.7
	Computed Tomography	148	66.7
	Magnetic Resonance Imaging	81	36.5
	Operating Room	67	30.2
	Interventional Radiology	47	21.2
	Radiotherapy	30	13.5
	Nuclear Medicine	22	9.9
	Breast Imaging	50	22.5
	Ultrasound (Sonography)	10	4.5
	Other	41	18.5
Do you use artificial intelligence in your private daily life? (e.g., searching for information, content generation, etc.)	Never	18	8.1
	Rarely (2–3 times a year)	41	18.5
	Sometimes (2–3 times a month)	65	29.3
	Often (2–3 times a week)	56	25.2
	Daily	42	18.9

3.2. Knowledge of and Experience with AI

Data indicated that most of the sample possesses a theoretical foundation on the subject (96.7%). A total of 52.3% reported knowing the basic principles of AI, while 31.5% held a general definition. Only 13.1% stated having in-depth knowledge, whereas the proportion of those who know nothing about it is very low (3.2%). Nevertheless, a significant gap existed between theoretical knowledge and practical application; specifically, 36.0% of radiographers have never used AI in their professional practice, while only a small proportion used it daily (13.1%). Combining those who use it "often" or "daily", the figure reaches approximately 32%, indicating that AI is already an established part of professional practice for one-third of operators (Table 2).

Table 2. AI knowledge and usage by Italian radiographers.

Questions	Levels	No.	%
Do you know what artificial intelligence (AI) is?	I don't really know what it is.	7	3.2
	I can give a general definition.	70	31.5
	I know the basic principles.	116	52.3
	I have in-depth knowledge.	29	13.1
Have you ever had the opportunity to use AI in your work?	Never	80	36.0
	Rarely (2–3 times a year)	35	15.8
	Sometimes (2–3 times a month)	36	16.2
	Often (2–3 times a week)	42	18.9
	Daily	29	13.1
In which phases do you believe AI is or could be integrated into radiology? (Max 3 answers)	Technical parameters selections	62	27.9
	Comparison with prior examinations	87	39.2
	Flagging areas requiring attention	81	36.5
	Assessment of correctness criteria	51	23.0
	Assessment of diagnostic quality	62	27.9
	Examination planning	51	23.0
	Suggestion of additional projections	35	15.8
	Pre-diagnosis	31	14.0
	Assessment of therapeutic quality	16	7.2
	Suggestion of additional interventions	9	4.1
	All responses	2	0.9
	Other	0	0.0
	Missing	1	0.5

Regarding the perceived potential for AI integration in the diagnostic pathway, the sample identified specific phases of the radiological workflow as most suitable for technological implementation. The area with the highest consensus was the comparison with prior examinations, as indicated by 87 respondents (39.2%). This was closely followed by the identification and flagging of areas requiring attention (36.5%), highlighting a strong expectation for AI as a support tool for detection (Computer-Aided Detection—CAD). Two areas recorded an identical frequency of 62 responses (27.9%). They were technical parameter selection and assessment of diagnostic quality. Furthermore, examination planning and

assessment of quality criteria both received 51 responses (23.0%). Conversely, applications perceived as less relevant or more distant from current practice pertained to phases closer to the clinical and therapeutic decision-making process, such as suggestions for additional projections (15.8%), pre-diagnosis (14.0%), assessment of therapeutic quality (7.2%), and additional interventions (4.1%). Notably, only 0.9% of the sample (n = 2) believed that AI could be integrated across all listed phases, whereas a single response was missing (0.5%).

3.3. Education and Training Needs on AI

The data presented in Table 3 illustrated the perceived readiness of Italian radiographers regarding AI integration and identified their most pressing educational needs.

Table 3. Education and training on AI by Italian radiographers.

Questions	Levels	No.	%
Based on your current training, how prepared do you feel regarding the use of AI in your work?	Unprepared	40	18.0
	Fairly unprepared	51	23.0
	Indifferent	35	15.8
	Fairly prepared	79	35.6
	Prepared	17	7.7
What do you believe are the primary training needs for your professional profile regarding the use of AI? (Max 3 answers)	Usage protocols	85	38.3
	Professional responsibility	83	37.4
	AI development mechanisms	70	31.5
	Verification of results	63	28.4
	Monitoring	38	17.1
	Technical aspects	69	31.1
	Ethical and deontological aspects	64	28.8
	Regulatory/Legal aspects	1	0.5
	All responses	2	0.9
	Other	0	0.0
	Missing	1	0.5

When respondents were asked to rate their current level of preparation on the use of AI in their work, 18.0% stated feeling unprepared, 23.0% fairly unprepared, 15.8% indifferent, 35.6% fairly prepared, and 7.7% prepared. Overall, 41.0% of the sample reported lower levels of preparedness (unprepared/fairly unprepared), whereas 43.3% reported higher levels of preparedness (fairly prepared/prepared). Among the training needs, the most frequently selected items were usage protocols (38.3%) and professional responsibility (37.4%). Training on AI development mechanisms (31.5%) and technical aspects (31.1%) were also commonly stated, as were verification of results (28.4%) and ethical/deontological aspects (28.8%). Monitoring was selected less frequently (17.1%), whereas regulatory and legal aspects were rarely reported (0.5%).

3.4. Perceived Impact of AI on Profession

The final section of the survey further investigated participants' perceptions of the opportunities offered by AI, the barriers to its integration, and its potential impact on the radiography profession from the perspective of Italian radiographers (Table 4). The survey further explored professionals' perspectives on the actual or potential contribution of AI implementation to their daily practice.

Table 4. Perceived impact of AI on profession by Italian radiographers.

Question	Level	No.	%
The contribution of implementing AI in your work is, or could be:	Extremely useless	2	0.9
	Fairly useless	13	5.9
	Indifferent	16	7.2
	Fairly useful	111	50.0
	Extremely useful	80	36.0
In your opinion, what are the main barriers preventing the use of AI in radiology?	Regulatory/legal/privacy/accountability	21	9.5
	Ethics and relational aspects	20	9.0
	Trust/reliability	27	12.2
	Resources/infrastructures/time	56	25.2
	Training	46	20.7
	Data collection and standardization	25	11.3
	Implementation/adoption	29	13.1
	Occupational risk/job displacement risk	4	1.8
	Error management	8	3.6
	Environmental impact	1	0.5
	No barriers (includes non-responses; "don't know" = missing)	17	7.7
In your opinion, what professional development opportunities does AI offer to radiographers?	Clinical benefits/quality and safety of care	51	23.0
	Workflow optimization/efficiency	32	14.4
	Procedural support	50	22.5
	Quality control and data	25	11.3
	Professional development	45	20.3
	Innovation/technology/research	16	7.2
	Other/unspecified	16	7.2
	No possibility (includes non-responses; "don't know" = missing)	23	10.4
Do you think that AI will be able to replace you in your job in the future?	Very unlikely	41	18.5
	Unlikely	121	54.5
	Indifferent	17	7.7
	Likely	43	19.4
	Very likely	84	37.8

Most participants attributed significant value to AI integration. Specifically, 50.0% of them (n = 111) believed that the contribution of AI is, or could be, "Somewhat useful", whereas 36.0% (n = 80) defined it as "Extremely useful". In total, 86.0% of the sample perceived AI as a beneficial resource for their professional workflow. In contrast, the proportion of professionals expressing skepticism or neutrality was notably small; namely, only 7.2% (n = 16) maintained a neutral position, 5.9% (n = 13) defined it as "Somewhat useless", and a minimal 0.9% (n = 2) deemed it "Extremely useless".

Open-ended responses regarding barriers to AI implementation and professional opportunities offered by AI were analyzed using an inductive content analysis approach.

For example, respondent no. 39 identified the following barrier to AI implementation: "The lack of information and training regarding the use of AI software." As concerns the professional opportunities offered by AI, the same respondent stated: "AI could expand the skills of the radiographers by providing immediate pre-diagnosis in order to shorten the report times by radiologists". Based on these responses, the research group identified the main barrier-related theme as the lack of AI training, which was classified under the thematic area "Training". In addition, such responses highlighted professional advancement, AI-assisted diagnosis, and workflow optimization, which were classified under the thematic areas "Professional development", "Clinical benefits/quality and safety of care", and "Workflow optimization/efficiency". Considering replies from the entire sample, the most frequently found categories on barriers to AI implementation in radiology were resources/infrastructures/time (25.2%), training (20.7%), implementation/adoption (13.1%), trust/reliability (12.2%), and data collection/standardization (11.3%). Regulatory/legal/privacy/accountability barriers were reported by 9.5% of respondents, followed by ethics and relational aspects (9.0%), error management (3.6%), occupational risk/job displacement risk (1.8%), and environmental impact (0.5%). No barriers were found in 7.7% of cases.

Regarding the opportunities offered by AI to foster professional growth, the most frequently recognized benefits included clinical benefits and safety of care (23.0%), procedural support (22.5%), professional development (20.3%), and workflow optimization (14.4%). A smaller subset (10.4%) indicated no professional opportunities.

When respondents were asked whether AI will be able to replace them in their future jobs, 18.5% (n = 41) and 54.5% (n = 121) of them believed it is "Very unlikely" and "Unlikely" respectively. Instead, this scenario was considered "Likely" by 19.4% (n = 41) and "Very likely" by 37.8% (n = 84) of respondents.

3.5. Associations with Professional AI Use and Self-Perceived Preparedness

Bivariate analyses showed that professional use of AI was significantly associated with higher self-perceived preparedness to use AI in the workplace ($p < 0.001$), indicating that respondents who claimed to use AI in their professional activity were more likely to feel prepared than those who did not. Professional AI use also varied significantly by geographic area ($p = 0.020$), with the highest proportion of users observed in central Italy (64.6%), followed by northern Italy (46.3%) and southern Italy/islands (37.3%). No significant associations emerged between professional AI use and employment sector, radiological process stages identified as suitable for AI integration, or barrier macro-categories. Among training needs, the only variable significantly associated with professional AI use was AI development mechanisms. Specifically, 60.0% of respondents who identified AI development mechanisms as a training need reported using AI in their work, compared with 42.8% of those who did not identify this need ($p = 0.021$). Among perceived professional opportunities, the only variable significantly associated with professional AI use was innovation/technology/research. Specifically, 75.0% of respondents who identified innovation, technology, or research as a professional opportunity reported using AI in their work, compared with 46.1% of those who did not identify this opportunity ($p = 0.036$).

With regard to self-perceived preparedness, no significant associations were found for geographic area, employment sector, barrier macro-categories, or opportunity macro-categories. Among work settings, working in magnetic resonance imaging was significantly associated with higher preparedness ($p = 0.025$). Among the radiological process stages, the only variable significantly associated with preparedness was pre-diagnosis. Specifically, 61.3% of respondents who identified pre-diagnosis as a relevant stage for AI integration stated feeling prepared, compared with 40.3% of those who did not identify this stage

(p = 0.033). Among training needs, the only variable significantly associated with preparedness was ethical and deontological aspects. Specifically, 54.7% of respondents who identified ethical and deontological aspects as a training need stated feeling prepared, compared with 38.6% of those who did not identify this need (p = 0.036). No significant associations were observed between self-perceived preparedness and the remaining variables.

4. Discussion

4.1. Sample Characteristics Analysis

The demographic profile of the sample, with a median age of 43 years, can be interpreted within the context of the national workforce, which has an average age ranging between 48.4 and 49.1 years.

The high prevalence of professionals working in the public sector (76.7%) requires a twofold reason. The first measure involves aligning the number of students admitted to bachelor's degree programs with the workforce demands of the Italian National Health Service, in compliance with existing regulatory standards (Ministerial Decree 70/2015, "Regulation defining qualitative, structural, technological, and quantitative standards for hospital care"). In this way, the Italian National Healthcare System has absorbed over time most new registered radiographers. The second reason is represented by the lack of an internationally standardized professional profile for radiographers, including within Europe, which limits international employment opportunities due to the lengthy process required for the recognition of professional qualifications, a process closely linked to the educational pathway defined by the Italian national radiographer profile [31].

4.2. Analysis of Knowledge of and Experience with AI

While the scientific literature has extensively examined the use of AI from radiologists' perspectives [18], the current study addressed the "professional blind spot" identified by Hardy (2020) by focusing on radiographers, who play a central role in the pre-analytical, image acquisition and processing phases of radiological practice.

Regarding AI adoption, the high level of engagement within our sample in their personal lives (about 82%) suggested a workforce primed for transformation with only 8.1% of respondents identifying as "never" users and more than 90% stating at least "minimum knowledge". However, the transition from personal familiarity to professional mastery requires a robust regulatory and educational framework. Such a framework should recognize radiographers not merely as "button pushers," but as human-in-the-loop professionals responsible for ensuring the ethical and technical integrity of AI-assisted image acquisition, in accordance with the Italian regulatory framework [31]. This professional stance reflects the interest in AI applications that support core technical activities, such as the selection of technical parameters (27.9%), the assessment of diagnostic quality (27.9%), and the evaluation of quality criteria (23.0%). These priorities reflect a desire to reduce mundane tasks while improving diagnostic accuracy [15]. Accordingly, our sample viewed AI primarily as a tool for technical and quality support rather than for pure diagnostics purposes, in line with the national regulations governing their professional practice. Simultaneously, the sample of the current study acknowledged that AI could help overcome the current regulatory boundaries regarding data access and pathology recognition, especially through comparison with prior examinations (39.2%) and flagging areas of interest (36.5%).

The statistically significant association between a high sense of preparedness and the identification of the pre-diagnosis stage as a strategic area for AI implementation (p-value = 0.033) further reinforced this trend.

The data revealed a professional category that was theoretically aware (96.7%) but practically underserved. Although enthusiasm for the potential of AI was sky-high, a signif-

icant readiness gap persisted. Italian radiographers in our sample were interested in clinical AI integration but remained unsupported in practice due to the heterogeneous tool availability [35]. Nearly half of the respondents (41.0%) still felt technically inadequate. Their primary demands included practical tools, specifically standardized protocols (38.3%), and regulatory clarity defining responsibilities (37.4%) to ensure safe and effective workflow integration. Secondarily, there was a growing awareness of the need to expand skills in radiomics and informatics engineering. This would allow radiographers to understand and control AI development mechanisms (31.5%) and to verify AI algorithmic results (28.4%). This positioning aligns with Persiani's 2019 study, which identified a strong commitment to managing new technological developments [25,26].

A direct consequence of these findings was the urgent need for specialized training. This training should cover not only the technical–professional aspects of service delivery [20], but more crucially how to manage patient education and communication on AI use, alongside the associated ethical and deontological implications (28.8%, p-value = 0.036) [6,16].

Currently, neither Directive 2013/59/Euratom—laying down basic safety standards for protection against ionizing radiation—nor its Italian implementation in Legislative Decree 101/2020 [36] has fully leveraged the radiographer's role in the care process. This has left a regulatory vacuum that European radiographers are collectively working to resolve [19,23].

Finally, it was noteworthy that only minimal differences existed between respondents with "poor" versus "good" AI training. This likely reflected the partial and heterogeneous diffusion of AI technology across Italy, as well as the emergence of ad hoc training courses that have not yet been standardized or integrated into formal university curricula.

4.3. Analysis of AI's Perceived Impact on Profession

In alignment with the existing literature [8,9], Italian radiographers in our convenience sample believed that AI could significantly enhance diagnostic quality, especially regarding clinical benefits, quality, and safety of care (23.0%), as well as quality control and data management (11.3%). Furthermore, AI was recognized for its potential in improving workflow efficiency, through procedural support (22.5%) and overall workflow optimization (14.4%). Indeed, the use of AI in radiology has been a subject of scientific research and debate for years. Consequently, the professionals interviewed—regardless of whether they currently use AI— formed a clear perspective on how this tool could be additionally integrated into radiographers' practice [5,6,37].

As previously mentioned, the advent of AI was perceived among Italian radiographers as a significant opportunity for professional development (20.3%), particularly within the domains of innovation, technology, and research (7.2%). Nevertheless, this momentum was tempered by various hindering factors of an organizational, ethical, and professional nature [16]. Specifically, progress was stalled by the limited availability of AI instrumentation (13.1%) and the lack of robust evidence regarding its practical impact, which effectively undermines professional trust and reliability (12.2%).

Current studies primarily focused on analyzing the general perceptions of professionals towards this technology [19,23,38]. However, to this day, it remains a critical need to investigate how AI affects non-technical dimensions that cannot be addressed by simple training, such as data management (11.3%), regulatory and accountability frameworks (9.5%), and ethical or relational aspects (9.0%), all of which currently lack standardized regulations. While some of the literature explored potential solutions through frameworks such as Organizational Health Literacy [27], it is difficult for respondents to redefine

their evidence-based practice without updated regulatory guidelines that account for the substantial impact of AI on clinical quality and healthcare organization [2,28].

Finally, the perspective of the sample on job security provided a critical concluding perspective. While most of the sample (54.5%) considered it "very unlikely" that AI will replace them in the future, a substantial minority (37.8%) perceived a total replacement as "very likely". This division suggests a professional identity in flux. The confidence shown by the majority likely stemmed from an awareness of radiographers' role in managing the technological process, a sentiment shared by Persiani [25] who noted that radiographers prioritized engagement in technology management (65.0%) as a core professional pillar. Nevertheless, the high percentage of those fearing replacement highlighted a lingering "technological anxiety" that may be exacerbated by the current readiness gap and the lack of formal integration of AI into university curricula. This dichotomy reinforces the need for a shift in the educational paradigm. As suggested by Malamateniou et al. and ISRRT [19,20], the transition from a "button pusher" to a gatekeeper of ethical and technical integrity is a viable path to mitigate these fears.

4.4. Study Limitations

The current study showed some limitations that should be carefully considered when interpreting the findings. Firstly, the use of a self-administered survey may have introduced social desirability and recall bias, potentially leading to over- or underestimation of participants' skills in the use of AI. Participants may have tended to provide responses that they perceived as more socially acceptable or professionally appropriate, rather than fully reflecting their actual knowledge, attitudes, or behaviors. In addition, the reliance on self-reported data is generally dependent on respondents' ability to accurately remember and evaluate their experiences and level of expertise, which may not always correspond to their actual competencies or everyday practices. Consequently, the reported levels of familiarity, confidence, and frequency of the use of AI should be interpreted with caution, as they may not perfectly mirror objective performance or actual engagement with AI tools in clinical or professional settings.

In addition, convenience sampling may not be representative of the entire population of radiology technicians in Italy, with a possible selection bias linked to the greater participation of individuals more interested in technological innovation. Although the current study was statistically adequate for an exploratory survey, 222 participants corresponded to a small fraction of the entire population of Italian radiology technicians. This consideration could lead to a self-selection bias since professionals already interested in or familiar with AI technologies might have been more likely to participate, potentially overestimating the digital preparedness and general enthusiasm of the profession. Consequently, the generalizability of the results to different regional and healthcare contexts should be considered with caution. Future studies should employ stratified random sampling and objective performance measures to confirm these preliminary findings.

5. Conclusions

The findings of the present study highlighted a pivotal moment for the Italian community of radiographers. The high level of engagement with AI in personal everyday life demonstrated a workforce that is culturally ready to embrace the change introduced by the advent of AI. Unfortunately, this individual readiness is still opposed by a significant institutional and practical "readiness gap", driven by Italian radiographers' perception of inadequate training in the use of AI and by the limited integration of acquired competencies into clinical practice. To bridge this gap, it is no longer sufficient to treat AI as a mere technical addition to the radiology suite. The transition of radiographers from a "button pusher"

to a "human-in-the-loop" requires a dual approach. The first approach is an educational reform in which AI and radiomics need to be formally integrated into university curricula and continuous professional developments in order to address the current educational gaps. Training should not only focus on technical operation but also on the ethical, deontological, and communicative skills necessary to manage AI-assisted patient care, ensuring workforce preparedness. The second approach is the evolution of current national and international regulatory frameworks. Italian and European legislations must evolve to explicitly define the radiographers' responsibilities within AI workflows.

Therefore, our data suggested that, as of today, AI represents an opportunity for professional growth rather than a replacement for humans. Future research should monitor how the implementation of the EU AI Act and the updating of national guidelines (such as Legislative Decree 101/2020) will impact the daily workflow and professional identity of Italian radiographers.

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References

1. *ISO/IEC TR 24028:2020*; Information Technology—Artificial Intelligence—Overview of Trustworthiness in Artificial Intelligence. Available online: https://www.iso.org/standard/77608.html (accessed on 18 May 2026).
2. Teo, Z.L.; Thirunavukarasu, A.J.; Elangovan, K.; Cheng, H.; Moova, P.; Soetikno, B.; Nielsen, C.; Pollreisz, A.; Ting, D.S.J.; Morris, R.J.T.; et al. Generative artificial intelligence in medicine Artificial intelligence is reshaping health systems: State of readiness across the WHO. *Nat. Med.* **2025**, *31*, 3270–3282. [CrossRef]
3. Pareek, S.B.; Lungren, A. Current and emerging artificial intelligence applications for pediatric interventional radiology. *Pediatr. Radiol.* **2022**, *52*, 2173–2177. [CrossRef]

4. Kelly, B.S.; Judge, C.; Bollard, S.M.; Clifford, S.M.; Healy, G.M.; Aziz, A.; Mathur, P.; Islam, S.; Yeom, K.W.; Lawlor, A.; et al. Radiology artificial intelligence: A systematic review and evaluation of methods (RAISE). *Eur. Radiol.* **2022**, *32*, 7998–8007. [CrossRef]
5. Hosny, A.; Parmar, C.; Quackenbush, J.; Schwartz, L.H.; Aerts, H.J.W.L. Artificial intelligence in radiology. *Nat. Rev. Cancer* **2018**, *18*, 500–510. [CrossRef]
6. Yasaka, K.; Abe, O. Deep learning and artificial intelligence in radiology: Current applications and future directions. *PLoS Med.* **2018**, *15*, e1002707. [CrossRef]
7. Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 Laying Down Harmonised Rules on Artificial Intelligence and Amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act). 13 April 2026. Available online: https://eur-lex.europa.eu/eli/reg/2024/1689/oj/eng (accessed on 18 May 2026).
8. Tang, A.; Tam, R.; Cadrin-Chênevert, A.; Guest, W.; Chong, J.; Barfett, J.; Chepelev, L.; Cairns, R.; Mitchell, J.R.; Cicero, M.D.; et al. Canadian Association of Radiologists White Paper on Artificial Intelligence in Radiology. *Can. Assoc. Radiol. J.* **2018**, *69*, 120–135. [CrossRef] [PubMed]
9. SFR-IA Group; CERF; French Radiology Community. Artificial intelligence and medical imaging 2018: French Radiology Community white paper. *Diagn. Interv. Imaging* **2018**, *99*, 727–742. [CrossRef]
10. van Leeuwen, K.G.; Schalekamp, S.; Rutten, M.J.C.M.; van Ginneken, B.; de Rooij, M. Artificial intelligence in radiology: 100 commercially available products and their scientific evidence. *Eur. Radiol.* **2021**, *31*, 3797–3804. [CrossRef] [PubMed]
11. Katzman, B.D.; van der Pol, C.B.; Soyer, P.; Patlas, M.N. Artificial intelligence in emergency radiology: A review of applications and possibilities. *Diagn. Interv. Imaging* **2023**, *104*, 6–10. [CrossRef]
12. Hung, K.; Montalvao, C.; Tanaka, R.; Kawai, T.; Bornstein, M.M. The use and performance of artificial intelligence applications in dental and maxillofacial radiology: A systematic review. *Dentomaxillofac. Radiol.* **2020**, *49*, 20190107. [CrossRef]
13. Nardi, C.; Tomei, M.; Pietragalla, M.; Calistri, L.; Landini, N.; Bonomo, P.; Mannelli, G.; Mungai, F.; Bonasera, L.; Colagrande, S. Texture analysis in the characterization of parotid salivary gland lesions: A study on MR diffusion weighted imaging. *Eur. J. Radiol.* **2021**, *136*, 109529. [CrossRef]
14. Langlotz, C.P. Will Artificial Intelligence Replace Radiologists? *Radiol. Artif. Intell.* **2019**, *1*, e190058. [CrossRef]
15. Waymel, Q.; Badr, S.; Demondion, X.; Cotten, A.; Jacques, T. Impact of the rise of artificial intelligence in radiology: What do radiologists think? *Diagn. Interv. Imaging* **2019**, *100*, 327–336. [CrossRef] [PubMed]
16. Strohm, L.; Hehakaya, C.; Ranschaert, E.R.; Boon, W.P.C.; Moors, E.H.M. Implementation of artificial intelligence (AI) applications in radiology: Hindering and facilitating factors. *Eur. Radiol.* **2020**, *30*, 5525–5532. [CrossRef]
17. Denisova, E.; Francia, P.; Nardi, C.; Bocchi, L. Advancements in biomedical rendering: A survey on AI-based denoising techniques. *Comput. Biol. Med.* **2025**, *197*, 110979. [CrossRef]
18. Hardy, M.; Harvey, H. Artificial intelligence in diagnostic imaging: Impact on the radiography profession. *Br. J. Radiol.* **2020**, *93*, 20190840. [CrossRef]
19. International Society of Radiographers and Radiological Technologists; The European Federation of Radiographer Societies. Artificial Intelligence and the Radiographer/Radiological Technologist Profession: A joint statement of the International Society of Radiographers and Radiological Technologists and the European Federation of Radiographer Societies. *Radiography* **2020**, *26*, 93–95. [CrossRef]
20. Malamateniou, C.; McFadden, S.; McQuinlan, Y.; England, A.; Woznitza, N.; Goldsworthy, S.; Currie, C.; Skelton, E.; Chu, K.Y.; Alware, N.; et al. Artificial Intelligence: Guidance for clinical imaging and therapeutic radiography professionals, a summary by the Society of Radiographers AI working group. *Radiography* **2021**, *27*, 1192–1202. [CrossRef]
21. Al Mohammad, B.; Aldaradkeh, A.; Gharaibeh, M.; Reed, W. Assessing radiologists' and radiographers' perceptions on artificial intelligence integration: Opportunities and challenges. *Br. J. Radiol.* **2024**, *97*, 763–769. [CrossRef] [PubMed]
22. Coakley, S.; Young, R.; Moore, N.; England, A.; O'Mahony, A.; O'Connor, O.J.; Maher, M.; McEntee, M.F. Radiographers' knowledge, attitudes and expectations of artificial intelligence in medical imaging. *Radiography* **2022**, *28*, 943–948. [CrossRef] [PubMed]
23. Stogiannos, N.; Walsh, G.; Ohene-Botwe, B.; McHugh, K.; Potts, B.; Tam, W.; O'Sullivan, C.; Quinsten, A.S.; Gibson, C.; Gorga, R.G.; et al. R-AI-diographers: A European survey on perceived impact of AI on professional identity, careers, and radiographers' roles. *Insights Imaging* **2025**, *16*, 43. [CrossRef]
24. Pedersen, M.R.V.; Kusk, M.W.; Lysdahlgaard, S.; Mork-Knudsen, H.; Malamateniou, C.; Jensen, J. Nordic radiographers' and students' perspectives on artificial intelligence—A cross-sectional online survey. *Radiography* **2024**, *30*, 776–783. [CrossRef]
25. Persiani, N. *Il Profilo del Tecnico Sanitario di Radiologia Medica in Italia*; Libreria Universitaria: Limena, Italy, 2019; p. 192.

26. Giusti, M.; Persiani, N. Italian Health Professions of the Technical, Rehabilitation and Prevention Areas to Support the Reform of Reference Healthcare System After COVID-19 Pandemic. In *Challenges of Healthcare Systems in the Era of COVID-19*; Contributions to Management Science; Persiani, N., Vannini, I.E., Romiti, A., Karasavvoglou, A., Polychronidou, P., Eds.; Springer: Cham, Switzerland, 2023. [CrossRef]
27. Giusti, M.; Nardi, C.; Bonaccorsi, G.; Lorini, C.; Persiani, N. Organizational Health Literacy as a supportive tool for the effective implementation of the 2013/59/EURATOM Directive in Italy. *Ann. Dell'ist. Super. Sanità* **2024**, *60*, 145–153. [CrossRef]
28. Giusti, M.; Beux, A.; Calandra, T.; Lorusso, S.; Gazzaniga, P.A.; Bonaccorsi, G.; Greco, G.; Persiani, N. Italian healthcare professionals' role in advancing reforms within the Italian National Healthcare System, as outlined in the National Recovery and Resilience Plan. *Front. Public Health* **2025**, *13*, 1603708. [CrossRef]
29. Creswell, J.W.; Creswell, J.D. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th ed.; Sage Publications: Thousand Oaks, CA, USA, 2017.
30. Setia, M.S. Methodology Series Module 3: Cross-sectional Studies. *Indian J. Dermatol.* **2016**, *61*, 261–264. [CrossRef] [PubMed]
31. Italian Governement. Ministerial Decree 746/1994 Regolamento Concernente l'Individuazione della Figura e del Relativo Profilo Professionale del Tecnico Sanitario di Radiologia Medica. 13 April 2026. Available online: https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=1995-01-09&atto.codiceRedazionale=095G0008&elenco30giorni=false (accessed on 18 May 2026).
32. European Federation of Radiographer Societies (EFRS). Statement on Artificial Intelligence. 2020. Available online: https://www.isrrt.org/wp-content/uploads/2023/07/ISRRT-EFRS-042020.pdf (accessed on 18 May 2026).
33. Kelley, K.; Clark, B.; Brown, V.; Sitzia, J. Good practice in the conduct and reporting of survey research. *Int. J. Qual. Health Care* **2003**, *15*, 261–266. [CrossRef]
34. Schoenherr, T.; Ellram, L.M.; Tate, W.L. A Note on the Use of Survey Research Firms to Enable Empirical Data Collection. *J. Bus. Logist.* **2015**, *36*, 288–300. [CrossRef]
35. van Leeuwen, K.G.; de Rooij, M.; Schalekamp, S.; van Ginneken, B.; Rutten, M.J.C.M. How does artificial intelligence in radiology improve efficiency and health outcomes? *Pediatr. Radiol.* **2022**, *52*, 2087–2093. [CrossRef] [PubMed]
36. Council Directive 2013/59/Euratom of 5 December 2013 Laying Down Basic Safety Standards for Protection Against the Dangers Arising from Exposure to Ionising Radiation, and Repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom. In Italy, the Directive Has Been Implemented Through Legislative Decree 101/2020, Issued Pursuant to Law 4 October 2019, No. 117, Which Also Reorganised the National Legislation on Radiation Protection. Available online: https://eur-lex.europa.eu/eli/dir/2013/59/oj/eng (accessed on 18 May 2026).
37. Rainey, C.; O'Regan, T.; Matthew, J.; Skelton, E.; Woznitza, N.; Chu, K.Y.; Goodman, S.; McConnell, J.; Hughes, C.; Bond, R.; et al. Beauty Is in the AI of the Beholder: Are We Ready for the Clinical Integration of Artificial Intelligence in Radiography? An Exploratory Analysis of Perceived AI Knowledge, Skills, Confidence, and Education Perspectives of UK Radiographers. *Front. Digit. Health* **2021**, *3*, 739327. [CrossRef]
38. Lutescu, D.A.; Manole, C.C.; Țâncu, A.M.C.; Ilinca, R.; Chau, R.C.W.; Felszeghy, S.; Didilescu, A.C. Can artificial intelligence in orthopantomography advance dental diagnostics through automated image analysis? *Front. Radiol.* **2026**, *6*, 1701356. [CrossRef] [PubMed]