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Introducing the Radiology Rotation-Model-22 in Clerkships: The RRM-Pocket Card for Medical Students – Part 1

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ABSTRACT

Practical training in radiology clerkships takes place alongside radiologists' daily patient care with an increasingly high workload. Medical students need to learn about different imaging exams in radiology rooms. Thus, practical training needs to encourage a self-active student approach. Giving insights into imaging, radiology departments are predestined for student rotation (SR) settings. The Radiology Rotation-Model-22 (RRM), introduced in part one of this study, was designed both as a tool and pocket card with department sections (10) for students in clerkships. Students can log data on tasks performed with the RRM-tool in a standardised documentation structure. They can self-observe and track individual SR by the method of participant observation (PO). The RRM-pocket card provides an overview of SR in radiology by PO across hospitals and medical offices. The RRM-model is department-related, and can optimise clerkship structure in busy clinical routine, and generate self-active training for medical students.

1. Introduction

1.1. Practical Training: Radiology Clerkships

High workload, and busy work schedules in medical care are increasing. While embracing more student-oriented educational approaches, clinicians need medical students to swiftly get engaged in clinical tasks in a self-active and self-organised manner to get prepared for patient care (Rahim & Ros, 2016; Kirch & Sadofsky, 2021). Practical training in radiology clerkships takes place in everyday clinical workflow at hospitals and medical offices in Germany – and across the world. Students are trained in medical settings alongside daily delivery of ongoing clinical care in complex patient management, multidisciplinary conferences, and tumor boards. Liu and Sullivan rightly point out that clinical teaching settings do vary from curricular settings, for being complex, challenging, and dynamic, thus unprecedented as an educational environment (Liu & Sullivan, 2021).

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Radiology overlaps with most medical specialties, as diagnostic and interventional imaging exams are necessary in deciding on clinical questions, be it in patient management at hospitals or medical offices, having made the specialty central and indispensable to patient care (Gunderman et al., 2003; Naeger et al., 2013; Chew et al., 2021; Simelane et al., 2021; Lynch et al., 2022). Being in this pivotal position, radiology teaching makes up an essential part of clerkships and rotations during clinical practice (Rizvi & Borges, 2020; Grimm et al., 2022). In this regard, radiology departments with separate imaging workstations and workplaces hold authentic opportunities for student rotations (SR). SR can be treated as potential teaching and learning settings, where prospective medical doctors are given insights into imaging. At the same time, they are expected to show initiative during elective clerkships, as this period comprises practical training. Oancea et al. have already underlined the profit a clinical radiology clerkship of several weeks brings along for students to learn imaging thoroughly (Oancea et al., 2013).

Radiologists and other medical specialists still call for more curriculum design, and delivery of imaging coverage in medical studies with radiologists in charge of teaching (Chew et al., 2021; Ayas et al., 2023). Moreover, students are encouraged to get acquainted with imaging exams, and to *make their way* through different departmental workstations. They should apply diagnostic imaging knowledge from the curriculum to case interpreting and reporting during radiology's everyday clinical practice (Rahim & Ros, 2016). Educating staff want and need students to efficiently get familiar with diagnostic and interventional imaging as a preparation for future medical practice (Murphy et al., 2014; Clements et al., 2022; Li & Brown, 2023; Wade et al., 2024). Clerkships in radiology take place alongside patient care and patient management with an increasingly high workload. Yet, it is important to consider that practical training still needs to be efficient, so as to generate a self-active student approach. The RRM-model can be applied to structure and optimise clerkships for medical students, radiologists, and radiographers in busy clinical routine.

2. Description of Method

2.1. The Radiology Rotation-Model-22: Participant Observation

We have developed the Radiology Rotation-Model-22 (RRM) (Appendices A and B) (January to October, 2022), to be employed as a pocket card in paper format for medical students during elective clinical clerkships and voluntary clerkships in radiology, i. e. short observations. RRM will be presented in two parts. To our knowledge such a model, or alike, is not available in the literature on radiology or medical education. RRM is designed to provide students with a handy documentation tool to log defined data by pen for personal SR overviews, including practical tasks assumed in separate radiology departments throughout medical studies (reading rooms, control rooms, imaging rooms). In RRM, departments are treated as separate sections, including reading rooms with workstations, control and imaging rooms with workplaces, while radiology is referred to as a medical specialty. RRM will equally be referred to as the RRM-pocket card and the RRM-tool (Appendices A and B).

Participant observation (PO) is chosen as a method by means of a standardised documentation structure according to Zierer et al. (Zierer et al., 2013). While having immediate access to settings concerned, SR in this case, PO can enable participating students to self-observe and affect their own clerkships' processes (Jorgensen, 2020; Döring, 2023). Since systematic and goal-oriented data logging of defined elements at a defined time is crucial in PO, the method is suitable for this model (Jorgensen, 2020; Döring, 2023). With clerkships completed at different hospitals, RRM can provide supervising radiologists with a precise overview of what

students have seen and have not yet seen in radiological imaging. Hence, it can be implemented as an operational support during high workload for medical education in clinical planning across departments.

Although interaction with additional educating staff is not specifically included, i. e. cooperating clinicians, medical scientists, resident physicians, any staff involved in open observations are, however, to be notified in advance about the RRM-pocket card's usage and aim, and documentation of PO procedures in that regard (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017). RRM is not designed to collect and process any personal or confidential data about teaching, supervising or other involved staff, or peers in any tool section, about patients and family members, or patient-related information (e. g. from patient communication, pre-examinations or examinations, multidisciplinary conferences or tumor boards, or clinical studies) concerning practical tasks (3rd section).

Encouraging the introduction of RRM, we wish to contribute to structured and efficient training, and self-active practical learning at hospitals and medical offices in radiology. The introduction of the RRM-model will be discussed by including literature on educational approaches to teaching practice in radiology mainly, and other medical specialties. Although adult education theories are non-medical, adult educational methods have long been adapted to the medical teaching environment (Kirch & Sadofsky, 2021; Kemp et al., 2022). Students are expected to swiftly get involved in thinking through demanding clinical questions under challenging learning conditions, so as to sufficiently get prepared for medical care (Linaker, 2015; Kirch & Sadofsky, 2021; Röcker et al., 2021). In this respect, RRM is informed by a teaching approach adjusted to the clinical environment in medical studies.

2.2. The Radiology Rotation-Model-Pocket Card: Student Rotation Settings

Departments can be treated as SR settings in training practice. From a methodological view, the structured PO setting is described as follows in this study: *where exactly*, in radiology departments; *when* and *for how long*, as in duration of elective clerkships (as in weeks), or short voluntary observations (usually as in a day, a few days and up to a week); and *under what circumstances*, as in real life settings, and regular everyday practice during clinical routine among medical students, radiologists, radiographers, and scientific staff in this case (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Jorgensen, 2020; Döring, 2023). Real life and daily contexts can be observed, documented, and described in a systematic procedure to collect data on a defined research question, and in a categorical structure, as in tool sections and elements in this case (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Döring, 2023). Authentic conditions can be logged by transparent and repeatable procedure based on a model – RRM as a newly designed model –, and examined by experiences gained (Atteslander, 2010; van Ophuysen et al., 2017).

The RRM-pocket card was developed for a doctor's coat pocket, with a tool design allowing for swift and convenient logging in a standardised structure (Zierer et al., 2013; van Ophuysen et al., 2017). The following question items were considered when creating the section elements: *what* is observed – defined elements of SR in radiology departments during clerkships; *for what purpose* are PO made – for personal overviews of SR in departments, and for the implementation of RRM as a rotation concept in radiology; *how*, *by whom* and *for whom* is data collection conducted – as a structured PO with the RRM-tool by students themselves, and for students during practical learning, and for radiologists during practical teaching in this regard (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Jorgensen, 2020; Lareau, 2021; Döring, 2023).

The department sections (10) of the RRM-pocket card are: computed tomography (CT), magnetic resonance imaging (MRI), chest radiology (CHX) and musculoskeletal radiology (MSK), ultrasonography (US), mammography (MG), pediatric radiology (PR), trauma radiology (TR), neuroradiology (NR), CT angiography (CTA) and MR angiography (MRA). There is an additional section for specialty rotations to or from nuclear medicine (NUC) and radiation therapy (RT) (imaging specialties), with further medical specialties for students in radiology, or for visiting students from cooperating specialties. The rationale behind selecting these sections can be explained in the availability of departments at most medical institutions. Single radiology departments in Germany can be attended across educational institutions (hospitals or medical offices) during SR. Thus, students have the opportunity to conduct PO at different medical facilities.

2.3. The Radiology Rotation-Model-Tool: Data Documentation

As a tool, the RRM-pocket card is designed for students of all clinical years to document respective data on SR in radiology departments on the same pocket card. According to the modified structure by Zierer et al. (Zierer et al., 2013), SR can be documented in defined tool sections (3) on the RRM-pocket card by every student: *type of rotation*, as in clerkship, or short observation (1st tool section, 1. My Department Rotation), i. e. department; *type and name of medical institution*, as in teaching hospital, university hospital, hospital (non-university hospital), and medical office, including time period (year, day or days, week or weeks) (2nd tool section, 2. Medical Institution); and *additional rotations* to or from imaging specialties, or cooperating specialties (1st tool section, 1.[1] Specialty Rotation). The first and second section illustrated on the front (Appendix A) show frame data, the back gives brief instructions on the practical usage. The third section on the back (Appendix B) shows data on performed practical tasks, as in actively joining radiologists and radiographers, *I joined*, i. e. patient (PT) communication, imaging examination or intervention, multidisciplinary conference (MC), multidisciplinary tumor board (MTB), or shift; and assisting medical educators, or practicing tasks themselves, *I did*, i. e. inserting venous shunts (VS), pre-measuring findings, or presenting a patient (PT) case (3rd tool section, 3. Practical Tasks). Completeness applies to the third section, as two possibilities can be noted: tasks performed and tasks not yet assumed, whereby relevant but not yet assumed tasks become visible in the same place (Atteslander, 2010; Zierer et al., 2013). This allows for a comprehensive SR overview, while showing practicing possibilities in single departments in one picture. Since activities and processes are observed at the time of occurrence, they cannot be captured entirely, while logging of significant variables is sufficient (Atteslander, 2010; Döring, 2023).

The initial RRM-tool was tested for suitability of structure and section elements, and for its applicability to SR and tasks. Design and pretest were undertaken in a teaching hospital setting of diagnostic and interventional radiology in Germany in 2022 along with medical students (approx. 2) in two different clerkships, and feedback was implemented. PO was considered suitable for students, being participants of clinical settings, and presumably having intrinsic motivation to complete clerkships (Jorgensen, 2020; Döring, 2023). Hence, the RRM-pocket card has been revised in a real hospital setting until visually concise subdividing and naming of category sections were reached, until usage was considered to be handy, clear, and appropriate for SR settings in this case (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Döring, 2023).

During data collecting, students – or participating observers –, assume an observing and documenting role with assumptions, and an actively participating one at the same time – in this regard one of interacting students practicing assigned tasks in authentic and concrete processes

–, so that this role cannot be regarded as an entirely objective one (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Jorgensen, 2020; Lareau, 2021; Döring, 2023). However, the standardised structure of defined sections and tool elements allows for clear and reliable documenting in lieu with clerkship structures, aiming for valid data collection (Zierer et al., 2013; van Ophuysen et al., 2017; Jorgensen, 2020; Döring, 2023). Educating staff, i. e. radiologists and radiographers, give instructions on the usage at the beginning of clerkships. It can be assumed that participating students have sufficient knowledge of respective structures in clinical training at medical institutions in Germany, so that defined essential variables can be captured with the tool in these PO settings (Atteslander, 2010; Zierer et al., 2013; Döring, 2023).

3. Discussion

3.1. Radiology Departments: Clerkship Teaching

At university and teaching hospitals, at medical offices, and at non-university hospitals, radiology departments hold potential authentic opportunities for teaching and learning practice in imaging. Yet, with workload increasing in medical care, teaching practice for radiologists and radiographers during clerkships takes place alongside busy workflow in everyday clinical routine. While delivering clinical care, and complex patient management, radiologists need to prepare for daily MC, MTB, and contribute to urgent case reporting (Munk, 2016; Petsch et al., 2020). Radiologists are increasingly involved in cancer diagnoses and therapies, and need to be involved in regular MTB attendance, demanding additional preparation time for case reviews to deliver upmost patient care, but which reduces student teaching involvement (Berardi et al., 2020; Neri et al., 2021). However, MC and MTB can be explored for efficient and authentic clinical training.

While the specialty is immensely diverse to begin with, one of the teaching roles is to get students familiar with different imaging exams and techniques in diagnostic and interventional radiology, as these prospective medical doctors will inevitably come across imaging in the course of their own medical practice (Oancea et al., 2013; Clements et al., 2022; Li & Brown, 2023; Wade et al., 2024). Overlapping with almost every medical specialty, thus performing diagnostic and interventional exams to decide on a variety of clinical questions, and performing radiological imaging for therapies, radiology is central and indispensable to patient management at hospitals and medical offices (Gunderman et al., 2003; Naeger et al., 2013; Chew et al., 2021; Simelane et al., 2021; Lynch et al., 2022; Horvat et al., 2023). Different SR are an excellent chance to explore manifold medical questions. Consequently, imaging is an integral component of MC and MTB settings for making diagnoses, detecting disease stages, and proceeding with patient therapies and treatments (Choi & Filice, 2020; Petsch et al., 2020). Students need to learn about different indications and contraindications for case reading and reporting in imaging, and about clinical diagnoses and differential diagnoses among other aspects (Petsch et al., 2021).

3.2. The Radiology Rotation-Model-22: Student Rotations

We argue that radiology departments are predestined for multiple SR in clerkships. For this reason, we have designed the Radiology Rotation-Model-22 for a doctor's coat pocket to provide students of all clinical years with the RRM-tool. Students can log and collect specific data through own PO on individual SR. The RRM-pocket card can conveniently be carried in a coat pocket during any rotation, allowing for swift and clear categorical logging in a

standardised structure (Zierer et al., 2013; van Ophuysen et al., 2017; Döring, 2023). As in *My Department Rotation*, students are encouraged to explore every SR.

Clerkships in any medical specialty ought to get students accustomed with medical routine, so as to sufficiently get prepared for future medical practice (Murphy et al., 2014; Röcker et al., 2021). Different SR in radiology principally aim to provide them with general and authentic insights into diagnostic and interventional imaging. Studies on medical teaching in radiology demonstrated that imaging has a crucial share in clinical clerkships and rotations (Rizvi & Borges, 2020; Grimm et al., 2022). Students with an explicit interest in interventional radiology, can for instance observe minimally invasive procedures at the CT-table. In this case, there might be a set interest to attend specific departments.

If students have become more aware of imaging, they are expected to steadily get engaged with observing in the reading room (Leschied et al., 2013). By using the pocket card for SR, they can look into imaging rooms thoroughly. There have been recent proposals for vigorous clinical rotation concepts in radiology, and more presence of interventional radiology in clerkships. (Lynch et al., 2022; Li & Brown, 2023; Burns et al., 2024). Yet, curricular radiology clerkships around the world are often electives, such as at state universities in Germany. Hence, several weeks of training should allow students to experience imaging in multiple departments as exhaustively as possible (Oancea et al., 2013; Murphy et al., 2014; Ayas et al., 2023). With its department overview, RRM can add to this encounter.

3.3. Observing and Logging

The RRM-pocket card illustrates an organised overview of single radiology departments available for individual SR, including practical tasks, which can also be assumed in a respective medical specialty, within a defined period in clerkships or short observations during regular clinical routine in patient care (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Jorgensen, 2020; Döring, 2023). Such systematic logging in PO, aiming at collecting data specific to daily SR settings in a defined structure, is a suitable method of documentation students can apply (Jorgensen, 2020; Döring, 2023). According to Jorgensen, PO is a method applied to gain detailed qualitative data, and to use this data, so as to develop new theoretical concepts and models, or to inform prevailing ones, e. g. in the field of education, or health care practice (Jorgensen, 2020).

RRM applied by means of PO, is a useful and doable methodical combination to be carried out by students in training. Data on newly gained knowledge in SR settings should be logged on the same card. The RRM-tool is handy for logging SR and tasks assumed during one or more clerkships of at least two weeks (15 days, Germany), or short observations of at least a day. The tool helps to reliably log relevant and valid data in three defined sections modified to students' respective practical training through systematic and clear steps, with descriptive information from real medical contexts, and on a daily SR basis (Atteslander, 2010; Zierer et al., 2013; van Ophuysen et al., 2017; Jorgensen, 2020; Döring, 2023).

Medical teaching in clinical routine, offers unprecedented complexity, challenge, and dynamics for students (Liu & Sullivan, 2021). Authentic conditions can be logged in such clinical contexts by transparent and repeatable procedure based on a model, and examined by experiences gained (Atteslander, 2010; van Ophuysen et al., 2017). In that regard, the RRM-pocket card is designed for students to log SR encounters they have in imaging departments.

3.4. I Joined-Tasks and I Did-Tasks

By employing the RRM-pocket card, students are encouraged to be self-active about tracking their own clerkships as they progress, i. e. which SR rounds they have been assigned to, and which workstations they would still like to see, which tasks they have assumed, and which practical skills need more practicing. With students becoming aware of medical skills that need more refining, or with knowledge that is still rather course-based and needs practical applying, they consciously put effort into overcoming deficits (Liu & Sullivan, 2021; Röcker et al., 2021; Simelane et al., 2021). They are advised to actively review their card entries during ongoing training. Entries can cover assisting preparing pediatric patients for X-ray exams, or performing ultrasound scans on children, and then joining radiologists in patient communication with parents in the PR department.

It is emphasised that students should be encouraged to join MC and MTB as to observe radiologists consult, and decide *live* on clinical decisions with multiple specialists involved (Munk, 2016; Mattes et al., 2017). Not every task performed in the third section is meant to be listed (3. Practical Tasks), but rather logged as a note that each of the four *I joined-tasks*, and each of the three *I did-tasks* have been performed at least once. Logging only the relevant data is needed, as it is not possible in PO to follow and document every single moment in rapid clinical workflow (Atteslander, 2010; Döring, 2023).

Note taking by students, for the third section in particular, should comply with ongoing routine activities, in this case with medical and medical-technical tasks in clinical routine, so that workflow mainly in control and imaging rooms, or in conference and tumor board settings, is neither impaired or tampered with, and that nondeliberate interruptions are kept at a minimum (Atteslander, 2010; van Ophuysen et al., 2017; Jorgensen, 2020; Döring, 2023). Yet, since medical staff happen to take notes during clinical tasks, and students during clerkship-related activities, logging with the RRM-pocket card should be feasible provided that it is adapted to busy workflow.

3.5. Department-Related Tool

When clerkships are completed across different hospitals or medical offices, the RRM-pocket card can help radiologists oversee what students have seen in imaging. This can minimise redundant rotation planning and rescheduling in clinical routine, and optimise operational clerkship structure. If training is completed at the same hospital, RRM can help medical educators across departments to quickly get an idea, which tasks have been assumed before assigning new activities, which yet require advanced skills. Students should for instance see the CHX and MSK department to learn the basics in the reading room, such as interpreting normal and abnormal findings in X-rays of the chest to detect pneumonia or pulmonary changes, or in the CT department to interpret CT scans of the head to verify or rule out traumatic brain injuries, skull fractures or skull base tumors, or the US department for ultrasound scans to examine the abdomen, inflammatory conditions in arthritis, or peripheral vascular diseases.

Imaging cases are presented to supervising radiologists and peers by discussing differential diagnoses, if applicable, and by jotting this down as *I did*. This leads us to what Branstetter et al. have long suggested, that students of all years in medical studies are well capable of gathering imaging knowledge on distinguishing normal and abnormal findings, and recognising disease stages (Branstetter et al., 2007). Logging with the tool is department-related and can be reviewed during every SR, in order to track readings of normal or abnormal findings, which students come across at different workstations, and log these as in *I did*. This gives them the opportunity to practice interpreting and reporting of self-chosen authentic and

unprecedented patient cases regarding single departments, and specific techniques, and to actively practice presenting by applying course knowledge in real life clinical settings (Rahim & Ros, 2016; Liu & Sullivan, 2021; Wachsman et al., 2023).

While being department-related, corresponding case readings can be logged in SR. By implementing the RRM-pocket card for rotation concepts in training, SR may gain more structure. This can help optimise radiology clerkships. In part two of this study, we will present the RRM-model regarding opportunities exploring SR in radiology rooms by keeping track with the RRM-pocket card.

4. Limitations

This study has a few limitations. Pretesting was conducted with a small number of medical students in clerkships during the COVID-19 pandemic. A larger number could result in more feedback. Yet, teaching practice had to re-settle after the pandemic. This study only refers to radiology departments at medical institutions in Germany. RRM can nonetheless be used for practical radiology training around the world; we assume that modifications have to be made. Despite of the model's standardised structure, there is no fixed proceeding in PO, which may lead to selective data collecting, and subjective understanding of results (van Ophuysen et al., 2017; Lareau, 2021; Döring, 2023). Nevertheless, PO is a suitable method for students to log SR, and track individual experience during training. Logging with the RRM-pocket card might be time consuming at the start of clerkships while getting used to clinical routine (Atteslander, 2010; Döring, 2023). It needs to be addressed that although RRM comprises multiple departments, it does not cover all clerkship aspects. This study may be gathered as a representative view of radiology clerkships at medical state institutions in Germany. The RRM-model is meant to be a holistic contribution to optimise clerkship structure for medical students, radiologists, and radiographers. Finally, we are aware that some of the font size on the front and back may be difficult to read. For reading convenience the RRM-pocket card may be distributed in enlarged printout. We wish to state that we do not intend to exclude anybody, if difficulties with reading small font should apply. Yet, it was the intention to fit defined variables into a pocket-size format.

5. Conclusions

Practical training takes place alongside daily delivery of patient care, and an increasingly high workload in clinical routine. Medical students need to learn about different imaging exams in radiology rooms. Radiology departments are predestined for SR settings in training practice. The Radiology Rotation-Model-22 (Appendices A and B) covering department sections (10) for SR, provides medical students of all clinical years with a pocket card. Students can systematically log data on department rotations and related tasks by PO during clinical clerkships and short observations across hospitals and medical offices. The RRM-pocket card provides students, radiologists, and radiographers with a structured overview of SR across departments and specialties. The RRM-tool is department-related, and can optimise clerkship structure in busy clinical routine, while generating self-active training for medical students. RRM can be implemented as a rotation concept for radiology clerkships, and will be discussed further in part two of this study.

Disclosure Statement

The authors declare that they have no conflicts of interest. The authors alone are responsible for the content and writing of this article.

Abbreviations

CHX: chest radiology
CT: computed tomography
CTA: CT angiography
MC: multidisciplinary conference
MG: mammography
MRA: MR angiography
MRI: magnetic resonance imaging
MSK: musculoskeletal radiology
MTB: multidisciplinary tumor board, multidisciplinary tumor boards
NR: neuroradiology
NUC: nuclear medicine
PO: participant observation
PR: pediatric radiology
PT: patient
RRM: Radiology Rotation-Model-22
RT: radiation therapy
SR: student rotation, student rotations
TB: tumor board, tumor boards
TR: trauma radiology
US: ultrasonography
VS: venous shunt, venous shunts
X-ray: Roentgen rays

References

Atteslander, P. (2010). Methoden der empirischen Sozialforschung [Methods of empirical social research] (13th ed.). Berlin, Germany: Schmidt Verlag. 73, 80, 82-84, 86-87, 89, 91-92, 94, 105 pp.

Ayas, G., Altinmakas, E., Rohren, SA., Dogan, H., Dogru, OF., Koselerli, EY., Turksanli, O., Efe, EÖ., Badawy, M., Kamel, S., Patel, P., & Elsayes, KM. (2023). Seeing Radiology Curricula Through Turkish Medical Students' Eyes: A Survey of Turkish Medical Schools' Radiology Education. J Med Educ Curric Dev, 10, 23821205231181990. https://doi.org/10.1177/23821205231181990

Berardi, R., Morgese, F., Rinaldi, S., Torniai, M., Mentrasti, G., Scortichini, L., & Giampieri, R. (2020). Benefits and Limitations of a Multidisciplinary Approach in Cancer Patient Management. Cancer Manag Res, 12, 9363-9374. https://doi.org/10.2147/CMAR.S220976

Branstetter, BF. 4th, Faix, LE., Humphrey, AL., & Schumann, JB. (2007). Preclinical medical student training in radiology: the effect of early exposure. AJR Am J Roentgenol, 188(1), W9-14. https://doi.org/10.2214/AJR.05.2139

Burns, L., Caterine, S., Walker, D., Ghumman, Z., & Lee, SY. (2024). One-week radiology boot camp for pre-clerkship medical students: A novel format improving image interpretation and confidence. Curr Probl Diagn Radiol, 53, 252-258. https://doi.org/10.2214/AJR.05.2139

Chew, C., O'Dwyer, PJ., & Young, D. (2021). Radiology and the medical student: do increased hours of teaching translate to more radiologists?. BJR Open, 3(1), 20210074. https://doi.org/10.1259/bjro.20210074

Choi, HH., & Filice, RW. (2020). Streamlining Radiologist Workflow for Multidisciplinary Conferences: A Web-Based System to Represent Radiology. J Digit Imaging, 33(3), 602-606. https://doi.org/10.1007/s10278-019-00317-w

Clements, W., Zia, A., Srinivas, A., Davis, J., & Goh, GS. (2022). A prospective cross-sectional study assessing teaching of interventional radiology across 20 Australian medical schools, endorsed by the Australian Medical Students Association. CVIR Endovasc, 5(1), 66. https://doi.org/10.1186/s42155-022-00344-9

Döring, N. (2023). Forschungsmethoden und Evaluation in den Sozial- und Humanwissenschaften [Research methods and evaluation in the social and human sciences] (6th ed.). Berlin: Springer. 323-332, 337, 342-344 pp. https://doi.org/10.1007/978-3-662-64762-2

Grimm, LJ., Fish, LJ., Carrico, CW., Martin, JG., Nwankwo, VC., Farley, S., Meltzer, CC., & Maxfield, CM. (2022). Radiology Stereotypes, Application Barriers, and Hospital Integration: A Mixed-methods Study of Medical Student Perceptions of Radiology. Acad Radiol, 29(7), 1108-1115. https://doi.org/10.1007/978-3-662-64762-2

Gunderman, RB., Siddiqui, AR., Heitkamp, DE., & Kipfer, HD. (2003). The vital role of radiology in the medical school curriculum. AJR Am J Roentgenol, 180(5), 1239-1242. https://doi.org/10.2214/ajr.180.5.1801239

Horvat, N., Oliveira, BC., Parente, DB., Souza, JWPS., Barbosa, LR., Beleza, IV., Cazagrande, GS., Resende, RS., Rohren, SA., Patel, P., Badawy, ME., Duran, MN., Abdullatif, U., Kamel, S., Stanietzky, J., & Elsayes, KM. (2023). Diagnostic radiology training for medical students - a Brazilian multicenter survey. Einstein (Sao Paulo), 21, eAO0184. https://doi.org/10.31744/einstein_journal/2023AO0184

Jorgensen, DL. (2020). Principles, Approaches and Issues in Participant Observation. London: Routledge. doi: 10.4324/9780367815080. 2, 4-5, 10-12, 36-37, 41, 43, 52, 103, 123-124 pp. https://doi.org/10.4324/9780367815080

Kemp, K., Baxa, D., & Cortes, C. (2022). Exploration of a Collaborative Self-Directed Learning Model in Medical Education. Med Sci Educ, 32(1), 195-207. https://doi.org/10.1007/s40670-021-01493-7

Kirch, SA., & Sadofsky, MJ. (2021). Medical Education From a Theory-Practice-Philosophy Perspective. Acad Pathol, 8, 23742895211010236. https://doi.org/10.1177/237428952–11010236

Lareau, A. (2021). Listening to People. A Practical Guide in Interviewing, Participant Observation, Data Analysis, and Writing It All Up. Chicago and London: The University of Chicago Press. 151, 166-167 pp. https://doi.org/10.7208/chicago/9780226806600.001.0001

Leschied, JR., Knoepp, US., Hoff, CN., Mazza, MB., Klein, KA., Mullan, PB., & Kelly, AM. (2013). Emergency radiology elective improves second-year medical students' perceived confidence and knowledge of appropriate imaging utilization. Acad Radiol, 20(9), 1168-1176. https://doi.org/10.1016/j.acra.2013.05.011

Li, D., & Brown, AD. (2023). Clinical Exposure to Interventional Radiology During Clerkship: A National Assessment of Canadian Medical Schools. Can Assoc Radiol J, 74(2), 462-464. https://doi.org/10.1177/08465371221134717

Linaker, KL. (2015). Pedagogical Approaches to Diagnostic Imaging Education: A Narrative Review of the Literature. J Chiropr Humanit, 22(1): 9-16. https://doi.org/10.1016/j.echu.2015.09.005

Liu, TH., & Sullivan, AM. (2021). A story half told: a qualitative study of medical students' self-directed learning in the clinical setting. BMC Med Educ, 21(1), 494. https://doi.org/10.1186/s12909-021-02913-3

Lynch, T., Bockhold, S., & McNulty, JP. (2022). Factors influencing the choice of radiology as a medical specialty in Ireland. Eur J Radiol, 151, 110297. https://doi.org/10.1016/j.ejrad.2022.110297

Mattes, MD., Gerbo, R., & Dattola, RM. (2017). Tumor Board Shadowing for Medical Students as a Means of Early Exposure to Multidisciplinary Oncology Education. J Am Coll Radiol, 14(2), 253-255. https://doi.org/10.1016/j.jacr.2016.07.009

Munk, PL. (2016). A Place in the Sun: The Importance of Radiology in Multidisciplinary Conference. Can Assoc Radiol J, 67(3), 203. https://doi.org/10.1016/j.carj.2016.06.002

Murphy, KP., Crush, L., O'Malley, E., Daly, FE., O'Tuathaigh, CM., O'Connor, OJ., Cryan, JF., & Maher, MM. (2014). Medical student knowledge regarding radiology before and after a radiological anatomy module: implications for vertical integration and self-directed learning. Insights Imaging, 5(5), 629-634. https://doi.org/10.1007/s13244-014-0346-0

Naeger, DM., Phelps, A., Kohi, M., Elicker, B., Ordovas, K., & Webb, EM. (2013). Reading room electives: say goodbye to the "radi-holiday". J Am Coll Radiol, 10(6), 442-448. https://doi.org/10.1007/s13244-014-0346-0

Neri, E., Gabelloni, M., Bäuerle, T., Beets-Tan, R., Caruso, D., D'Anastasi, M., Dinkel, J., Fournier, LS., Gourtsoyianni, S., Hoffmann, RT., Mayerhöfer, ME., Regge, D., Schlemmer, HP., & Laghi, A. (2021). Involvement of radiologists in oncologic multidisciplinary team meetings: an international survey by the European Society of Oncologic Imaging. Eur Radiol, 31(2), 983-991. https://doi.org/10.1007/s13244-014-0346-0

Oancea, L., Gunderman, R., Carrico, C., & Straus, C. (2013). Teaching radiology in medical school: an association for medical student educators in radiology survey. Acad Radiol, 20(2), 255-256. https://doi.org/10.1016/j.acra.2012.09.021

Petsch, I., Velasco González, A., & Buerke, B. (2020). Multidisciplinary Conferences for Radiology Teaching: Why Medical Students Should See the Significance of Imaging and Lifelong Learning. European Journal of Teaching and Education, 2(4), 1-9. https://doi.org/10.1016/j.acra.2012.09.021

Petsch, I., Velasco González, A., & Buerke, B. (2021). Teaching Radiology Courses: How to Address Learning Needs of Medical Students Through Interacting in Radiology. European Journal of Teaching and Education, 3(1), 44-51. https://doi.org/10.33422/ejte.v3i1.400

Rahim, S., & Ros, P. (2016). Moving Away From Spoon-Feeding as a Teaching Style in Radiology. AJR Am J Roentgenol, 207(6), 1232-1238. https://doi.org/10.33422/ejte.v3i1.400

Rizvi, T., & Borges, NJ. (2020). "Virtual Radiology Workstation": Improving Medical Students' Radiology Rotation. Med Sci Educ, 30(1), 117-121. https://doi.org/10.1007/s40670-020-00920-5

Röcker, N., Lottspeich, C., Braun, LT., Lenzer, B., Frey, J., Fischer, MR., & Schmidmaier, R. (2021). Implementation of self-directed learning within clinical clerkships. GMS J Med Educ, 38(2), doc43. https://doi.org/10.3205/zma001439

Simelane, T., Ryan, DJ., Stoyanov, S., Bennett, D., McEntee, M., Maher, MM., O'Tuathaigh, CMP., & O'Connor, OJ. (2021). Bridging the divide between medical school and clinical practice: identification of six key learning outcomes for an undergraduate preparatory course in radiology. Insights Imaging, 12(1), 17. https://doi.org/10.1186/s13244-021-00971-1

van Ophuysen, S., Bloh, B., & Gehrau, V. (2017). Die Beobachtung als Methode in der Erziehungswissenschaft [Observation as a method in education science]. Konstanz and Munich: UVK Verlag. 18-19, 39, 41, 53, 72, 80, 82-84, 99, 103-104, 119 pp.

Wachsman, U., Shelef, I., Lior, Y., & Ben-Arie, G. (2023). The impact of interactive clinically-based learning on the performance of medical students in radiology. Eur J Radiol Open, 10: 100493. https://doi.org/10.1016/j.ejro.2023.100493

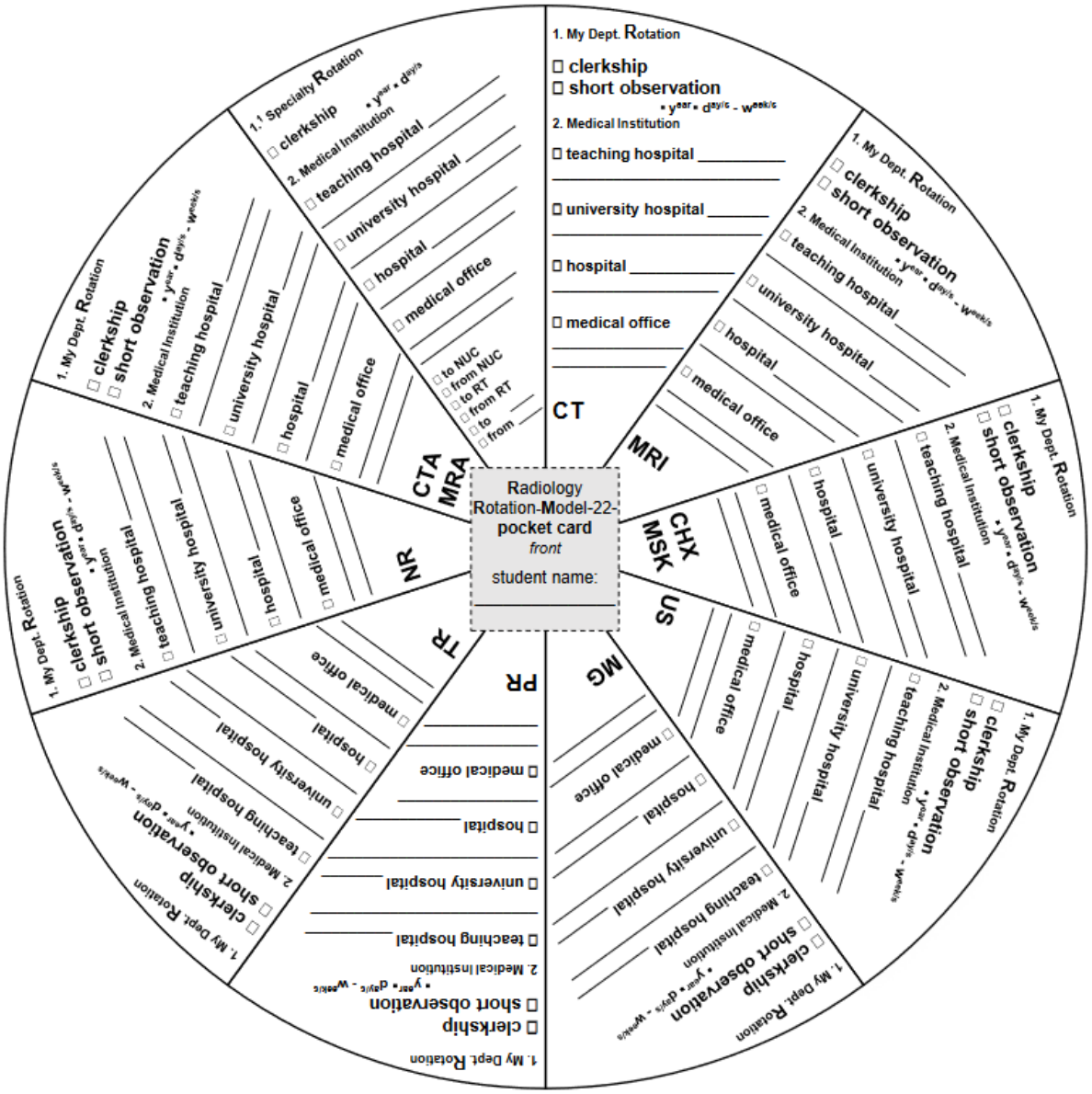
Wade, SWT., Velan, GM., Tedla, N., Briggs, N., & Moscova, M. (2024). What works in radiology education for medical students: a systematic review and meta-analysis. BMC Med Educ, 24(1):51. https://doi.org/10.1186/s12909-023-04981-z

Zierer, K., Speck, K., & Moschner, B. (2013). Methoden erziehungswissenschaftlicher Forschung [Methods of educational research]. Munich: Reinhardt Verlag. 84-87, 89-90, 93 pp. https://doi.org/10.36198/9783838540269

Appendix

Appendix A

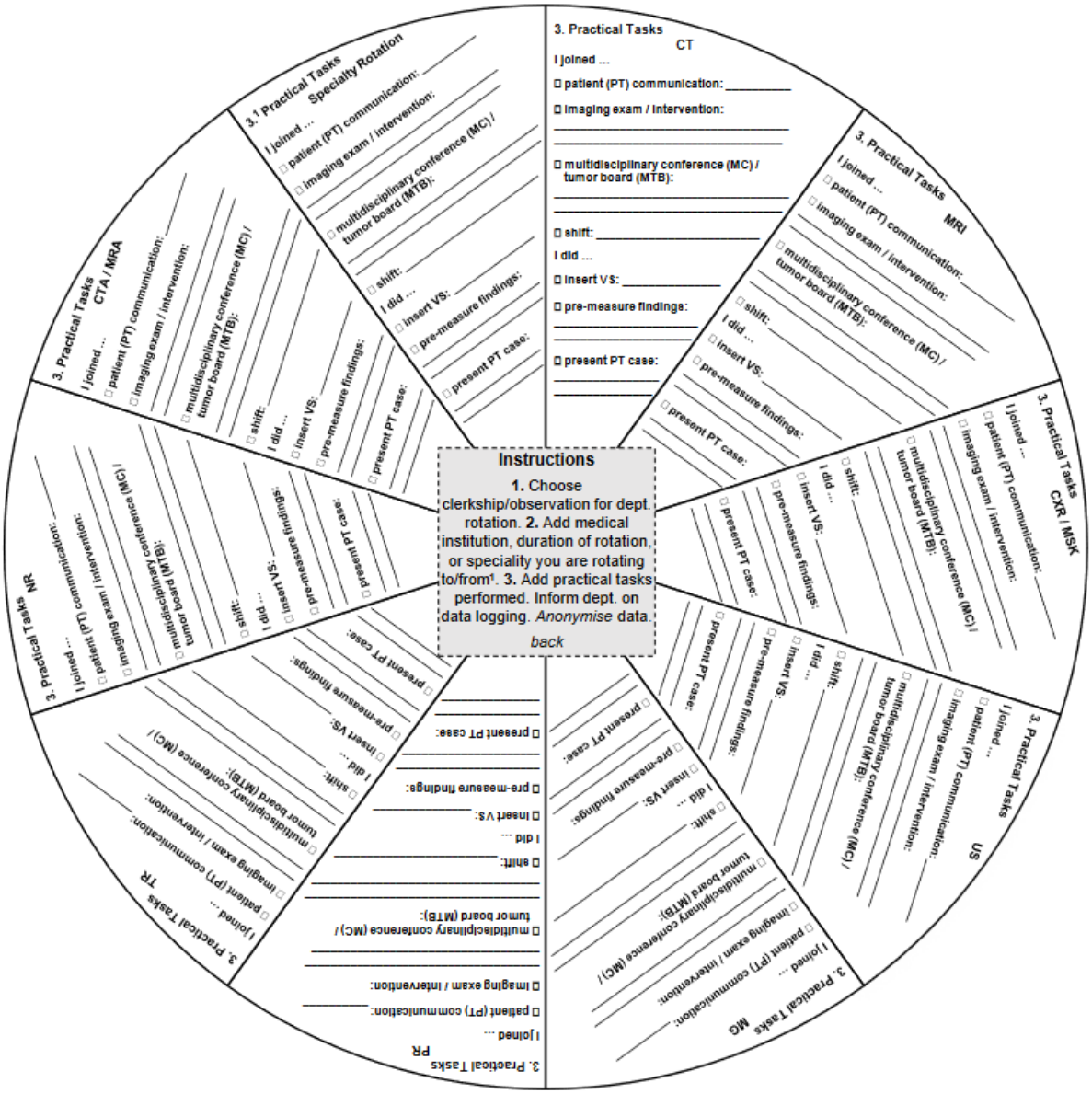
Illustrated RRM-Pocket Card's Front Side



Note. RRM-pocket card's front side with 1st section and 2nd section, from the Radiology Rotation-Model-22 for clerkships and short observations in radiology, as modified own presentation model based on documentation structure according to Zierer et al. (Zierer et al., 2013)

Appendix B

Illustrated RRM-Pocket Card's Back Side



Note. RRM-pocket card's back side with 3rd section, from the Radiology Rotation-Model-22 for clerkships and short observations in radiology, as modified own presentation model based on documentation structure according to Zierer et al. (Zierer et al., 2013)