Developing A Medical Photography Best Practice Guide and Teaching Technical and Ethical Principles to Clinicians - An Exploratory Sequential Mixed Methods Study

Farid F Ibrahim, M.B.B.Ch, MD

Department of Family Medicine – Medical Education Option

McGill University, Montreal

Canada

August 2018

A thesis submitted to McGill University in partial fulfillment of the requirements of the degree of Masters of Science in Family Medicine – Medical Education Option

Table of Contents

List of abbreviations

DSLR - Digital Single Lens Reflex

MUHC - McGill University Health Centre

REB - Research Ethics Board

OR - Operating Room

ExPerT - Expert-Performance-based Training

ISO - International Organization of Standardization

RT - Right

LT - Left

mm - millimeter

cm - centimeter

m - meter

HD - High definition

APS-C - Advanced Photographic System Type C

CCELL - Camera, Composition, Exposure, Lens, Light

MCP - metacarpophalangeal

CCC - Consent, Confidentiality, Copyright

N – Number

FMSQ - Fédération des médecins spécialistes du Québec

JFI - Journée de formation interdisciplinaire

Stand - Standard

CQDPCM - Conseil québécois de développement professionnel continu des médecins

Abstract

Introduction: Obtaining medical photographs is becoming increasingly important in the practice of family physicians and medical specialists. Photos are used for many purposes such as clinical case management, clinical documentation, teaching, research or even as forensic evidence. There is paucity of knowledge about medical photography in the era of digital single lens reflex (DSLR) cameras, and until today, there are no published guidelines or protocols to direct medical photography users. The objectives of this study are to; 1) identify unperceived educational needs in medical photography, 2) develop a best-practice guide that can help physicians master their photography skills and change their practice accordingly, 3) teach these principles to medical specialists and family physicians.

Methods: We conducted a literature review that was followed by a systematic review. An exploratory sequential mixed methods study design was applied using the results of both reviews. A qualitative research design employing a qualitative descriptive methodology was used, and followed with a quasi-experimental study to validate the results. Concerning the qualitative phase, a maximum variation purposive sampling approach was used to include medical photographers with a different range of age groups, and years of experience since training. Recruitment continued until data saturation was reached. In total, six semi-structured in-depth interviews were carried out with six medical photographers who were working in the Greater Montreal area in Canada. For the quantitative phase, twenty physicians were invited to participate in a hands-on workshop that presented the results of the qualitative phase. All twenty participants had to go through an assignment before and after the workshop. Assignments' results were compared to test and validate the best-practice guide. Finally, a questionnaire was sent to

all attendees seeking their feedback, which should be considered in future studies.

Results: According to the literature and the systematic review in addition to the qualitative study respondents, the main challenges that face medical photography users are adjusting camera and lens, exposure, focal length, lighting, patient positioning, photo composition, patient consent, confidentiality and copyright. The ABC camerawork guide for Dr. photographer was crafted. The fruit of all this work was used in our final project; consisting of teaching the best-practice guide through a hands-on workshop to practicing physicians, which successfully perfected their medical photography abilities and enhanced their practice.

Conclusion: This work resulted in a best-practice development that assists physicians in benefiting from the strengths of medical photography to enhance their practice and patient care.

Résumé

Introduction: La photographie devient de plus en plus importante dans le cadre de la pratique des médecins. Elle est devenue une habitude pour plusieurs médecins, qui s'en servent dans la prise en charge clinique, à des fins de documentation, comme outil d'enseignement ou de recherche, et même comme preuves médico-légales. Il y a un manque de connaissance sur la photographie médicale avec les appareils photo reflex mono-objectifs numériques (DSLR) et à ce jour il n'existe pas de lignes directrices ni de protocoles pour guider les utilisateurs. Les objectifs de cette étude sont; 1) d'identifier les connaissances manquantes en photographie médicale, 2) de développer un guide des règles de l'art qui aidera les utilisateurs de la photographie médicale à maîtriser leurs compétences en photographie et changer leur pratique en conséquence, 3) de partager le résultat final de cette étude avec les médecins spécialistes et les médecins de famille.

Méthodes: Nous avons effectué une revue de la littérature suivie par une synthèse systématique dont les résultats ont contribué à une étude exploratoire et séquentielle à méthode mixte. Un modèle de recherche qualitative employant une méthodologie descriptive et qualitative était utilisé, suivi par une étude quasi expérimentale pour valider les résultats. En ce qui concerne la phase qualitative, les photographes étaient choisis à partir d'une méthode d'échantillonnage avec écart maximal, afin d'avoir des photographes de différents groupes d'âge et d'expérience. Le recrutement s'est réalisé jusqu'à la saturation des données était atteinte. Au total, six entrevues en profondeur et semi-structurées étaient menées avec six photographes médicaux qui travaillent dans la région métropolitaine de Montréal. En ce qui concerne la phase quantitative, vingt médecins étaient invités à participer à un atelier pratique dont les données ont contribué à

la phase qualitative. Tous les vingt participants devaient accomplir une tâche avant et après l'atelier. Ensuite, les résultats étaient comparés pour évaluer et valider le guide des règles de l'art. À la fin, un questionnaire était envoyé à tous les participants en vue d'obtenir leur rétroaction pour des études futures.

Résultats: Selon la recherche, l'analyse et la rétroaction des participants de l'étude qualitative, les défis pour les utilisateurs de la photographie médicale sont le réglage de l'appareil photo et de l'objectif photographique, ainsi que le temps de pose, la distance focale, l'éclairage, le positionnement du patient, la composition photographique, le consentement du patient et la confidentialité et le droit d'auteur. L'ABC de la photographie médicale était conçu avec le but d'enseigner un guide des règles d'art à travers un atelier pratique. Cet atelier a réussi à améliorer les compétences des utilisateurs de la photographie médicale et a réformé leur pratique en conséquence.

Conclusions: Notre étude a abouti à une élaboration d'un guide des règles de l'art pour aider les médecins à utiliser les forces de la photographie médicale pour mieux server leurs patients.

Contributions of authors

Dr. Farid F Ibrahim designed and adapted the research protocol, conducted the literature review, systematic review, in-depth interviews, hands-on workshop, data collection, and data analysis of all three manuscripts included in this thesis. The overall concept of the research, as well as the original protocol, interview guide and workshop logistics, were developed in collaboration with Dr. Sam J Daniel, and was reviewed by Dr. Gillian Bartlett along with the thesis committee. Dr. Ibrahim was solely responsible for writing the outline and first draft of the thesis and the manuscripts, which were critically reviewed by the supervisors. Dr. Sam J Daniel, Dr. Gillian Bartlett and the members of the thesis committee – Dr. Lisa Trimble and Dr. Tamara Carver – provided their guidance along the journey of constructing the whole project.

Acknowledgements

I would like to express my profound gratitude to my supervisor, Dr. Sam J Daniel for believing in me, and providing me with supportive guidance along this journey of learning and discovery. Without his continuous support and mentorship, my projects would not have ever come to life. Also, I would like to express my great appreciation to Dr. Gillian Bartlett who has acted as my co-supervisor. I greatly value the unique support of my thesis committee members; Dr. Tamara Carver and Dr. Lisa Trimble. Their suggestions and essential feedback guiding the research and the write-up of this thesis were of great help and benefit. I am also grateful to Dr. Charo Rodriguez, Dr. Pierre Pluye, and Dr. Alexandra De Pokomandy who have provided me with the required foundation in research methodology leading to this thesis.

I would like to thank Dr. Coralie Vachon, Ms. Marie-Josee Bouchard, and Ms. Patricia Wade for their technical assistance, Dr. Lorraine LeGrand Westfall for her generous contribution to the work, and Ms. Tiziana Principe and Ms. Taylor Felix for proofreading the thesis. I am very grateful to my inspirational photographer Mr. Bill Stefaros who believed in my passion and skills. To my other colleagues, residents, fellows and friends who consistently created a motivating friendly environment at the McGill Otolaryngology, and Family Medicine departments, thank you!

Above all, I want to express my deep appreciativeness to my parents, siblings and best friend Valentine, for their endless support that has helped me overcome many obstacles in life, particularly my father Dr. Fathy Elwekeel who has always been my source of motivation and inspiration.

This research project was conducted under the supervision of McGill University Health Centre (MUHC), McGill Research Institute, McGill department of Otolaryngology – Head and Neck Surgery, and McGill department of family medicine. The study was approved by the MUHC Research Ethics Board (REB), and funded by a McGill Master's training grant, a graduate excellence award in Family Medicine and a graduate excellence award in Medicine to Dr. Farid Ibrahim.

CHAPTER ONE: Introduction

1.1 Introduction

1.1.1 History of medical photography

Photography, which is explained by drawing with light, was created in 1825 [1]. Joseph Niepce was able to craft the first long-lasting photograph by using asphalt and a polished pewter plate combined with light exposure [2]. Doctors and scientists of that era were fascinated by the photo-making revolution, and started to apply photography in medical education and training, as well as scientific researches [3]. The first known application of photography in medicine took place in 1840, 15 years after photography was created, when Alfred Donne used his lens to document bones that included teeth, and cells from different body organs at Charité Hospital in France [3, 4]. A decade later, photographs started to appear in medical journals [4]. The first journal which was solely dedicated to photographic medical and surgical materials was published in Pennsylvania 45 years after creating photography [4].

By the early 1900s, advanced photography was used by different medical specialists including surgeons, pathologists, dermatologists, radiologists and psychiatrists [3]. Colour photography, portable cameras and chipped digital devices were the major technological improvements that shaped the foundation of modern photography [1, 5]. Though the first colour images were taken in the late 1800s, colour camerawork was not easily accessible until the early 1900s [1, 2]. Photography continued to advance thereafter, especially with the advent in the 1970s of the first digital camera by Steven Sasson [3]. However, despite this monumental development, digital photography was not widespread until the 1990s [3, 4].

The photography industry propagated the integration of digital photography and cellular phones around the year 2000, which dramatically advanced photography to its current state of instantaneous accessibility [5].

1.1.2 Integration of medical photography in the health system

Photography has revolutionized the way healthcare professionals document, communicate, and administer medical and / or surgical care [3]. It allows for a higher level of precision and adds value to the verbal description. The four main fields where medical photography is frequently used are medical consultation and documentation, medical education and training, patient and family education, and medical publications and presentations [5].

1.2 Research Problem

1.2.1 Current technology is a barrier to medical photography users

Digital technology has substantially simplified the acquisition and management of photographs [5]. It has allowed healthcare providers to routinely take photos in different clinical and surgical settings, rather than relying on medical photographers. However, literature is lacking when it comes to modern medical photography guidelines as well as protocols required to guide the use of photography in medical practice [5, 6]. Concerning quality standards required for publications, small compact cameras (point and shoot cameras) are not considered sufficient, regardless of their ease of use, and portability [5]. Moreover, photographs that are part of a clinical record, scientific research or that eventually may be subject to either public or professional scrutiny necessitate a higher standard in terms of both quality and management [5]. It is imperative that professors and medical educators teach anatomy and surgical techniques using images with high quality

resolution, definition, and colour so that the transition from teaching to practicing is as seamless as possible [5, 6].

Taking images in the operating room (OR) is not as simple as it seems; because of the requirement of sterility and the high brightness of surgical light-heads. These conditions make it thought-provoking to introduce the camera equipment in the OR, along with the major inconvenience of having to deglove frequently for different photo opportunities [6]. However, a professional-level modern digital camera is fairly lightweight and effortlessly manageable. Indeed, once camera settings are adjusted for a specific situation, such as a close-up view or a wide shot in an operating room, minimal to no changes are required, and a teammate can easily be guided to take the photographs [5, 6].

1.2.2 There is a need for a photography guideline

A guideline should be established to create a coherent system to acquire, manage and access photographs, and to ensure the integrity of these sensitive data [5-7]. The workflow should also confer simplicity and uniformity to image capture and for subsequent data management [7]. Medical images that might be used in presentations, teachings, printouts or online publications do require informed consent from patients. Additionally, to alleviate any privacy concerns, these images should be de-identified, so that visual recognition of the person is not possible [7]. De-identification also involves text on the photograph and data within the image and the electronic file name as well.

1.3 General Objectives

The study aims to explore the missing knowledge in this area in order to develop and test a guideline that can help medical photography users master their photography skills and change their practice appropriately.

1.4 Audiences for the Study

The study targets clinicians and surgeons including medical residents in training. Medical educators and clinical teachers should also benefit from the study results as well.

1.5 Purpose Statement

Medical photography will continue to evolve, likely becoming ubiquitous, if it has not already reached this significance. Therefore, the aim of this multi-phase project is to explore the knowledge needed in order to create a best-practice guide. The latter should provide concrete solutions to the current challenge physicians and residents face in utilizing the strengths of medical photography with proficiency.

CHAPTER TWO: Background & Literature Review

2.1 Literature Review

2.1.1 The four main fields where medical photography is frequently used

2.1.1.1 Medical documentation and consultation

Medical documentation is a crucial aspect of the process of patient care. Photography assists healthcare providers in accurately describing and diagnosing a clinical disorder, and monitoring its progression over time [5]. Dermatology and plastic surgery - domains in which visual inspection is fundamental - have already amalgamated camerawork into routine practice [5]. Documentation is becoming increasingly more important in our continually evolving healthcare system, particularly when different healthcare professionals are assessing patients over subsequent visits. Photography can additionally facilitate communication and collaboration within a team of multiple physicians and nurses, proving to be more beneficial to the patient [5, 6]. Furthermore, in the operating room, image capture using digital cameras has become omnipresent [6, 7]. Additionally, photographic records are often used as decisive evidence for legal proceedings [8]. Medical consultations in the era of digital photography have also changed; considering the possibility to obtain expert assistance while being home based, or through physician-to-physician consultation [5]. It enhances the efficiency and the convenience for both the patient and the physician whereas also being cost-effective. Moreover, for rural and community hospitals and clinics, telemedicine is exceptionally beneficial to support and broaden attendants' competences and experiences using visual communication, so as to aid patients in the best and fastest way possible.

2.1.1.2 Medical education and training

As stated by Fred R. Barnard in 1927 that "*A photo is worth ten thousand words*". The role of photographs in medical education is actually as essential as text, if not more. Medical education entails knowledge and understanding of a significant amount of information over a short period of few years, along with the ability to think critically [9]. The current decrease of work hours, and clinical and operative experience, combined with the increase in patient demand for quality service and optimized outcomes, require educators and trainees to maximize coaching opportunities and pursue alternative avenues for furthering medical knowledge, awareness and training [9]. It is unfeasible for medical students and residents in training to encounter all diseases, especially the uncommon ones, so photographs constitute a solid way to compensate for this lack of exposure [9]. The use of images as scholastic material is increasingly essential in every area of the current medical practice.

2.1.1.3 Patient and family education

Education using visual images serves not only the healthcare providers, but also the patients and their families. Photography is a great tool for doctors in order to help patients understand their illnesses [10]. For instance, intra-operative photographs could be used to concretely illustrate the findings and exemplify a future course of an operation, while pre and post operative images show the progression [7, 10].

2.1.1.4 Medical publications and presentations

For as long as the photograph has existed, medical images have been used in textbooks, teaching atlases, presentations, articles and journal reports [4]. They are also used to distribute detailed information about new diseases, very rare cases, unique presentations of common diseases, and new medical and surgical managements.

2.1.2 Current Challenges

A recent study published by Harting and colleagues in 2015 revealed "*it is very challenging for clinicians and surgeons to continue to utilize the strengths of medical photography with proficiency and without compromising patient privacy*" [10]. Therefore, a simplified yet highly applicable guideline is needed to help healthcare providers understand how an image can be properly crafted using the basic principles of photography (shutter speed, aperture size, camera sensitivity to light, composition, exposure) and the appropriate equipment (DSLR camera, lens, flash) without compromising any ethical or legal aspects of the patient's right to privacy [10]. A minimal amount of training is necessary to understand photographic principles, become familiar with the equipment and master technique, positioning and lighting skills [11]. This ensures that the process of image taking is efficient and does not unduly interrupt any clinical or operative procedure, which should be the primary aim of a physician. A Brazilian study done in 2017 presented that diagnostic medical photographs should be reproducible and standardized, which allows accurate evaluation of medical cases [11]. In the last 15 years, different authors have published photography protocols that are used in their daily practice [12-16]. These guidelines standardize lighting, camera setting, framing, and patient positioning to obtain a good medical photograph, but have not been tested for accuracy or applicability. In 2014, a study published by Uzun et al., discussed that medical photography standards have never been well-established in general medical practice and many specialties as well [17]. To date, there is no available tool to guide the physician in using his / her camera in the medical practice.

2.2 Knowledge Gap and Research Needed

Current evidence clearly demonstrates the importance of medical photography in up-to-date practice and modern medical education. However, there is a lack of knowledge about technical aspects, data management, ethical issues and legal aspects of medical photography using DSLR cameras [10]. The aim of this study is to explore the missing knowledge in this area, and to develop and test a tool that can help physicians master their photography skills.

2.3 Theoretical Model

The results of the study were reached by applying a modified Expert-Performance-based Training (ExPerT) theoretical model [18]. This model was initially modified in order to be suitable for developing an effective and applicable guideline that could eventually improve healthcare profession [Fig 1].

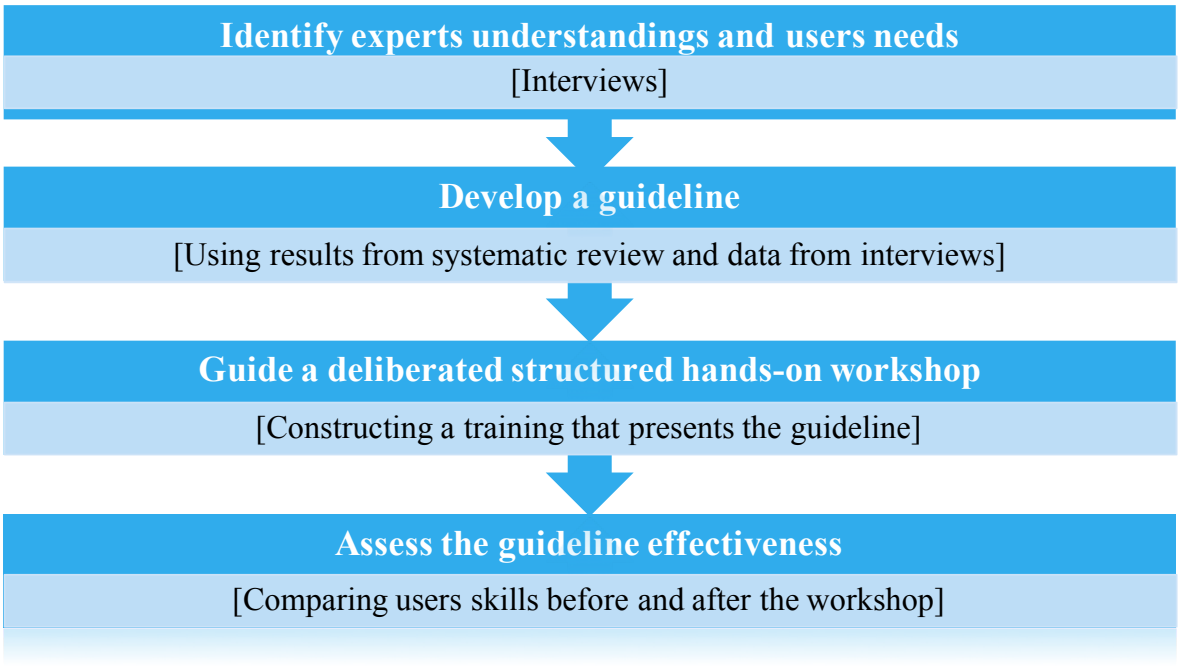


Figure 1: Theoretical model

2.4 Research Objectives

The primary objective is to identify technical and ethical challenges that face medical photography users and develop a best-practice guide that assists medical educators, clinicians, surgeons and residents in using cameras in clinical settings. Establishing a guide should improve physicians' awareness of the importance of medical photography, and also improve their skills and practices. The secondary objective is to teach and test the guideline through a hands-on workshop directed at a group of medical specialists in multiple disciplines.

2.5 Research Questions

2.5.1 Systematic review question

What are the essential technical and ethical elements in medical photography?

2.5.2 Qualitative research question

What are the elements needed to understand modern medical photography and to develop a relevant best-practice tool for healthcare providers?

2.5.3 Quantitative research question

Amongst medical photography users, how can their medical photography skills and applications improve after applying the guideline?

CHAPTER THREE: Overall Methodology

3.1 Overall Methodology

The current study was proposed to develop and establish the content of a medical photography best-practice guide to be used by healthcare providers, including residents in training. The study was conducted through a systematic review that was followed by a two-phase mixed methods research design.

3.1.1 A systematic review

A systematic review was conducted and included studies dedicated to medical photography guidelines and issues or applications in either clinical practice, or medical education. All articles published in English in the last 15 years were addressed. Medline, Embase and Cochrane library databases were searched by two independent researchers using the following terms ((medic* or clinic*) adj3 (photograph* or photo or photos or camera* or multimedia*)). After applying pre-identified criteria, eligible studies were included in a data-based convergent synthesis. Results from the review, along with the literature review, were used to construct an interview guide.

3.1.2 A mixed methods study (exploratory sequential design)

Mixed methods exploratory sequential design was used in this study. It is a two-phase design that starts by qualitatively exploring knowledge that helps to build an instrument that could be used in a subsequent quantitative phase. For that reason, this design has been referred to as the instrument development design by Creswell et al., in 2004 [19]. The purpose of the exploratory design is to generalize findings based on a few individual interviews from the qualitative phase to a representative sample gathered during the quantitative phase.

3.1.2.1 Phase one

Phase one was to answer the research question defining all aspects related to modern medical photography and to construct an applicable guideline. This was done by applying a qualitative description methodology. This methodology was chosen in particular because it represented the best fit for our study questions and needs. Qualitative description stands for rich and direct description of an event or experience with low inference interpretation. In other words, interpretation is carried on even if the main task is descriptive [20]. Nevertheless, qualitative description does not offer a high level of interpretation as in other methodologies where the researcher can present an experience in the light of a philosophical or conceptual framework [21]. Qualitative description has been utilized to explore underrepresented areas in healthcare sectors [20]. This applies to the principal aim of our study as we were interested in creating a guideline for modern medical photography. The latter should fill out the knowledge gap in the current literature.

3.1.2.2 Phase two

Phase two consisted of testing the new guideline. The medical photography guide was tested by comparing results obtained from an assignment given to residents and physicians before and after exposure to a hands-on workshop. This was done by applying a quasi-experimental study design. This methodology was chosen in particular because it represented the most suitable approach for the study phase. The lack of randomization due to the small sample size made the one group pre-test – post-test quasi design the optimal choice. Quantitative studies result in data that provide quantifiable, objective, and easy to interpret results. The latter should be easily reproduced.

CHAPTER FOUR: Systematic Review

Technical and Ethical Principles of Modern Medical Photography: A Systematic Thematic Synthesis Review

Farid F Ibrahim [a, b], MD; Sam J Daniel [a], MD

[a] Department of Otolaryngology-Head and Neck Surgery, The Montreal Children's Hospital, McGill University, Montreal, QC, Canada

[b] Department of Family Medicine, McGill University, Montreal, QC, Canada

Keywords: clinical, photography, digital, techniques, ethics, medical

Running Head: Principles of Modern Medical Photography

Contribution of authors:

Farid F Ibrahim contributed to the design of the review, data base search, data collection, analysis and interpretation, and drafting the manuscript.

Sam J Daniel contributed to the design of the review, data analysis and interpretation, and critical revision of the manuscript draft.

Authors in Order:

Farid F Ibrahim
Department of Family Medicine – Medical Education
Department of Otolaryngology – Head and Neck Surgery
McGill University

The Montreal Children's Hospital, McGill University
1001 Boul Decarie
Montreal, QC H4A 3J1
farid.ibrahim@mail.mcgill.ca

Sam J Daniel
Department of Otolaryngology – Head and Neck Surgery
McGill University

The Montreal Children's Hospital, McGill University
1001 Boul Decarie
Montreal, QC H4A 3J1
sam.daniel@mcgill.ca

4.1 Abstract

Introduction:

Photographs that are part of a clinical record or a medical case management necessitate a higher standard in terms of both quality and management. However, literature is lacking when it comes to modern medical photography guidelines as well as protocols required to guide the skills and usages of photography in the medical practice.

Methods:

A comprehensive search for relevant articles was carried out on five different electronic databases. Articles published in English in the last 15 years were eligible for review. Using predefined inclusion criteria, published articles on medical photography practices, were selected, reviewed, and their findings were synthesized. A thematic synthesis methodology was applied to identify key elements in the selected studies.

Results:

Four studies met the inclusion criteria for this review. They addressed technical and / or ethical issues in medical photography protocols. Synthesis of the findings identified ten analytical themes, which were described more deeply. These elements included camera exposure, lighting applied, lens, background, patient distance, image framing, consent, copyright, equipment proprietorship, and image management.

Conclusion:

The themes highlight the potential for a properly-crafted and validated guideline. Further exploration is needed to construct a best-practice that assists physicians in being competent at utilizing the strengths of medical photography.

4.2 Introduction

Photography is increasingly considered as an intrinsic part of modern medical practice [1-3]. Over the last decade, it has evolved as a great tool for medical consultation and documentation, medical education and training, as well as medical publications [4]. The advent of modern digital technology has simplified the technique of taking photographs. Although it is easy to use point and shoot - compact - camera systems, the end result is not always satisfactory for the purpose of clinical managements, documentations, education, or presentations [5-7]. On the other hand, a professional level camera - digital single lens reflex (DSLR) – which is known for it's high quality results, ought to be suitable in the field of medical photography [5]. A DSLR camera contains a mirror that reflects light to the viewfinder [Fig 1]. In addition, it has a wide image sensor allowing higher level of resolution and true color saturation [8, 9]. Correct photographs created by DSLR systems are usually valid, reproducible and reliable [10, 11]. Nevertheless, a certain degree of training is required to become familiar with the camera system and to understand the standards of photography [4, 6].

A camera functions the same way a human eye does. It is a dark box with only one opening (aperture) for light to enter. The camera sensor is similar to the eye retina, and a photograph is produced when the light falls on the sensor, which is the photosensitive area. A photograph is then passed to a camera processor and memory card where it gets managed and stored. Processor and memory card here represent the camera brain. The main three fundamentals of crafting a proper light-exposed photo are shutter speed, aperture, and international organization of standardization (ISO) [12].

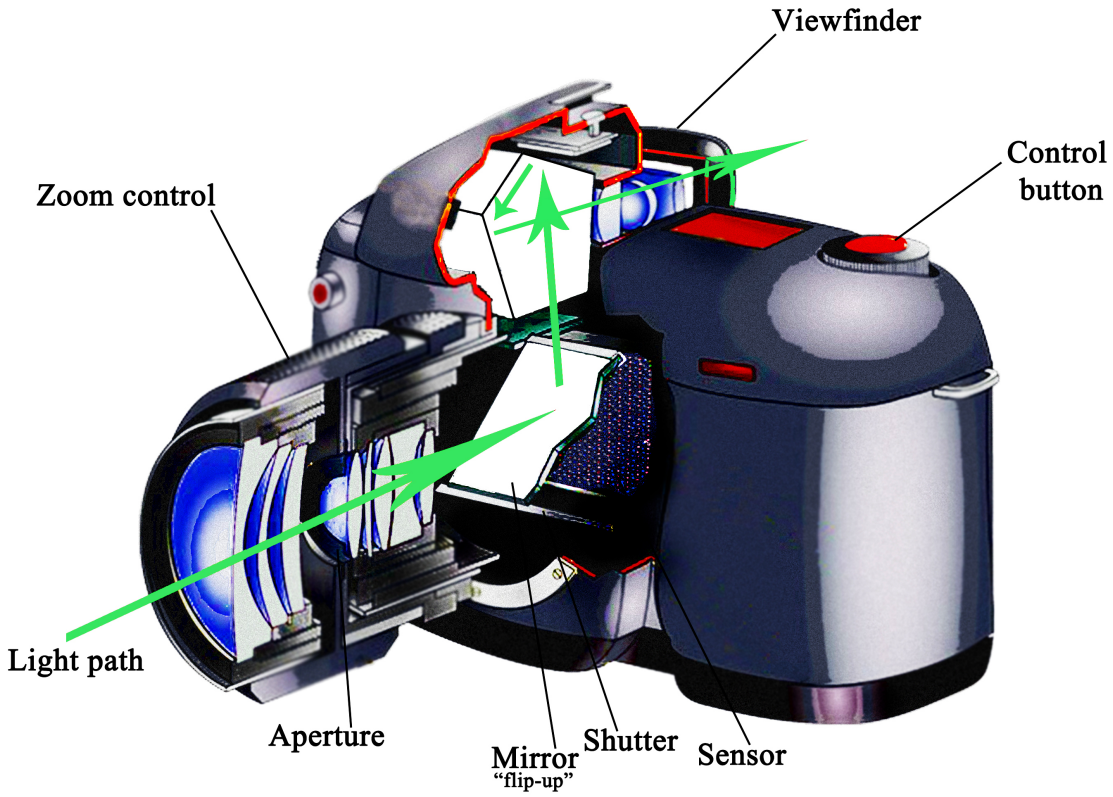


Figure 1: DSLR camera system and light path

Shutter speed controls the duration of the camera shutter opening to take the photo. In other words, it is the speed of opening and closing the shutter [12]. The faster the shutter, the less the light that reaches to the camera sensor [6, 12].

Aperture size is the opening size through which light travels to the camera sensor [Fig 2]. The wider the opening, the more the light, the narrower the depth of field [13]. Depth of field is the depth of layers that are in focus. Expressly, the greater the depth of field, the sharper the image [14-16].

ISO controls the camera sensitivity to light. The more the ISO, the more the sensitivity to light [12, 17]. High ISO level leads to more image graininess – noise; which is different pixel variations and shows as tint freckles [18].

A recent review done by Harting and colleagues in 2015 showed a perplexity regarding technical and ethical aspects of producing a quality crafted medical photograph in the era of digital cameras [4]. Therefore, we chose to conduct a qualitative synthesis review to help healthcare providers apprehend how an image can be properly produced and managed; by simplifying the complexity of a camera system, as well as principles, techniques and ethics of medical photography.

4.3 Review Question

What are the technical and ethical elements needed to produce a quality medical photograph?

4.4 Materials and Methods

4.4.1 Eligibility criteria

Our literature exploration identified articles which had reported medical photography technical and / or ethical guidelines or protocols among our target population groups. The latter include clinicians, medical educators, surgeons, and medical photographers. All were, English-language publications discussing medical photography technical elements, ethical elements, or guidelines in either clinical practice or medical education published in the last 15 years since modern medical photography using DSLR cameras is novel to medical practice and education. Commentaries, conference abstracts, theses, posters, case reports, and letters were not considered eligible, and articles with duplicated data were excluded.

4.4.2 Sources of data

A literature search was conducted in five different databases, namely Medline, Biosis, Embase, Web of Science, and Cochrane library databases. Figure 2 shows that the search strategy included the text words; medic, clinic, patient, digital, photograph, photo, photos, camera. Also, keywords such as photography, image processing, and computer-assisted were used. Finally, the search was limited by text word in title or abstract to articles with terms designating a technical or an ethical focus: guide, standard, procedure, practice, technique, technical, ethical, ethics, protocol, policy, policies, framework, principle, guideline, or guidelines.

Terms Used	Variations of Terms to use when searching
Medical Photography	• ((medic* or clinic* or patient* or digital*) adj3 (photograph* or photo or photos or camera*)).ti,kf. • ((medic* or clinic* or patient* or digital*) adj3 (photograph* or photo or photos or camera*)).ab. /freq=2 • Photography/ or Image Processing, Computer-Assisted/
Techniques and/or Ethics	• (guide* or standard* or procedur* or practic* or protocol* or policy or policies or framework* or principle* or technique* or technical* or ethics* or ethical*).tw,kf. • exp guideline/ or exp Guidelines/ or exp technical/ or exp technique/ or ethical/ or ethics as Topic/

Figure 2: Keywords used in database search

4.4.3 Search strategy

Cursory screening of the pre-limitation set was performed and identified several articles that were further selected to be included. Additionally, reference lists of selected articles were searched for additional relevant studies. Duplicates were removed by using

EndNote's Author/Title/Year duplicate checker, followed by a manual verification of duplicates [Fig 3].

Medline [Ovid]

Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily 1946 to Present

#	Searches	Results
1	((medic* or clinic* or patient* or digital*) adj3 (photograph* or photo or photos or camera*)).ti,kf.	1763
2	((medic* or clinic* or patient* or digital*) adj3 (photograph* or photo or photos or camera*)).ab. /freq=2	1526
3	1 or 2	2862
4	(guide* or standard* or procedur* or practic* or protocol* or policy or policies or framework* or principle* or technique* or technical* or ethics* or ethical*).tw,kf.	3526523
5	3 and 4	1014
6	Photography/ or Image Processing, Computer-Assisted/	127822
7	exp guideline/ or exp Guidelines as Topic/	163290
8	6 and 7	280
9	5 or 8	1276
10	remove duplicates from 9	1256
11	("23465212" or "23556494" or "25708063").ui.	4
12	remove duplicates from 11	3
13	10 and 12	3
14	limit 10 to English	1162
15	limit 14 to year="2002 -Current"	950

Embase [Ovid]

Embase; 1974 to 2017

#	Searches	Results
1	medical photography/	4285
2	exp practice guideline/	422686
3	1 and 2	137
4	((medic* or clinic* or patient* or digital*) adj3 (photograph* or photo or photos or camera*)).ti,kw.	1861
5	((medic* or clinic* or patient* or digital*) adj3 (photograph* or photo or photos or camera*)).ab. /freq=2	1969
6	4 or 5	3311
7	(guide* or standard* or procedur* or practic* or protocol* or policy or policies or framework* or principle* or technique* or technical* or ethics* or ethical*).tw,kf.	4551022

8	6 and 7	1284
9	3 or 8	1410
10	limit 9 to English language	1319
11	limit 10 to year="2002 -Current"	1128
12	limit 11 to (conference abstract or conference paper or conference proceeding or "conference review")	273
13	11 not 12	855
14	remove duplicates from 13	821

Cochrane [Wiley]

ID	Search	Results
#1	((medic* or clinic* or patient* or digital*) near/3 (photograph* or photo or photos or camera*)):ti,ab,kw	1183
#2	(guide* or standard* or procedur* or practic* or protocol* or policy or policies or framework* or principle* or technique* or technical* or ethics* or ethical*).ti,ab,kw	307298
#3	#1 and #2 Publication years: 2002-2017	537

Web of Science [Thomson-Reuters]

#	Searches	Results
# 1	ti=((medic* or clinic* or patient*) near/3 (photograph* or photo or photos or camera*)) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=2002-2017	419

Biosis [Ovid]

BIOSIS Previews; 1969 to 2017

#	Searches	Results
1	((medic* or clinic* or patient*) adj3 (photograph* or photo or photos or camera*)).ti,mi.	379
2	((medic* or clinic* or patient*) adj3 (photograph* or photo or photos or camera*)).ab. /freq=2	169
3	1 or 2	540
4	(guide* or standard* or procedur* or practic* or protocol* or policy or policies or framework* or principle* or technique* or technical* or ethics* or ethical*).ti,ab,mi.	2258116
5	3 and 4	115
6	limit 5 to English language	108
7	limit 6 to year="2002 -Current"	59

Duplication & Removal of Records

Duplicates were removed by using EndNote's Author/Title/Year duplicate checker

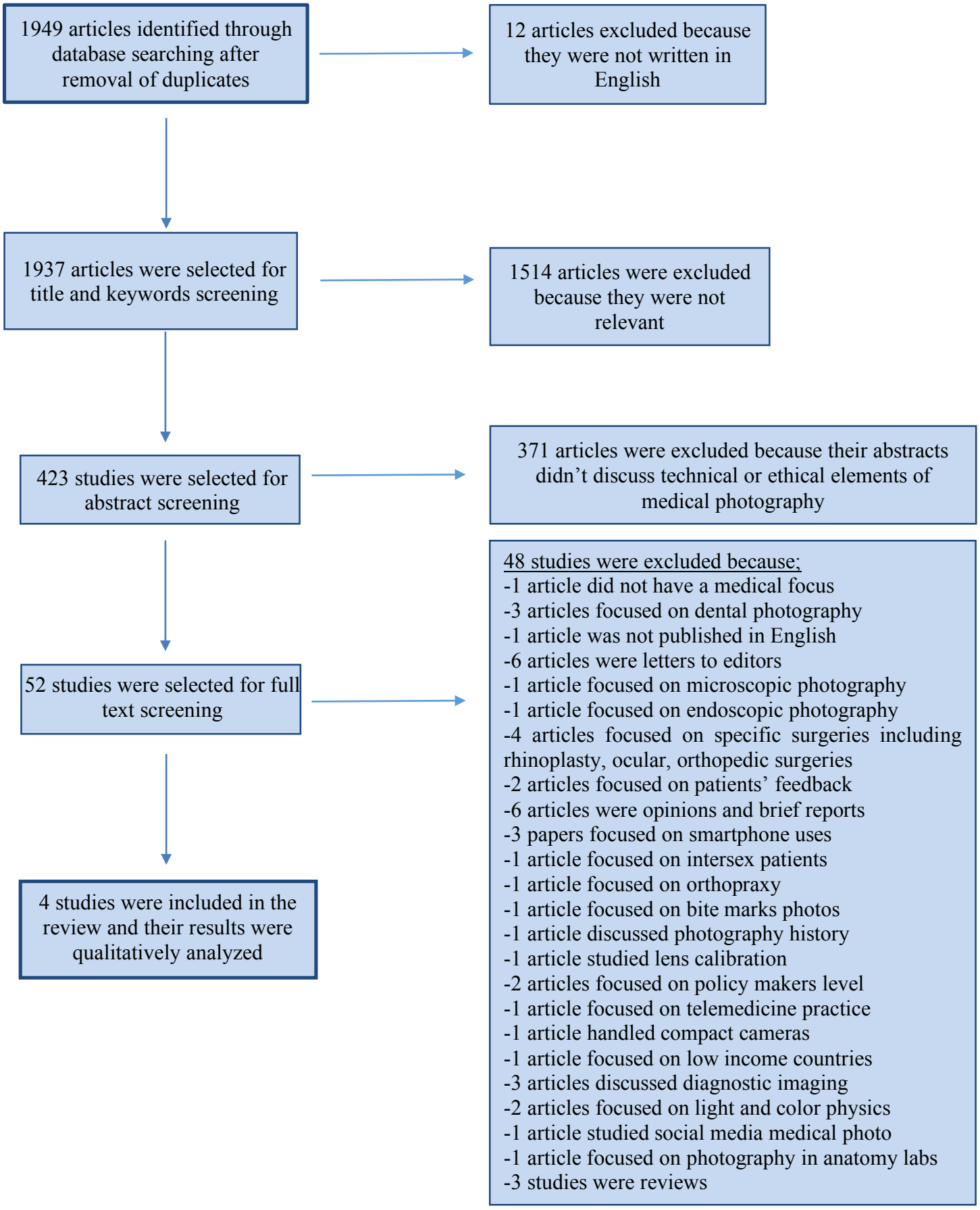
Database	Before Duplicate Removal	After Duplicate Removal	% Retained
Biosis	16	16	100%
Cochrane	537	464	86%
Embase	821	199	24%
Web of Science	419	323	77%
Totals	**2743**	**1949**	**77%**

Figure 3: Electronic search at databases

4.4.4 Study Selection

Initially, a complete and comprehensive database search to screen the articles' titles, abstracts, and keywords was performed manually using EndNote by two independent researchers. Then, the full text was reviewed to determine eligibility of the articles according to predefined criteria [Fig 4]. Findings were appraised and synthesized based on study type, ethical element and technical aspect reported.

Figure 4: Study selection strategy



4.4.5 Data extraction

Studies were grouped on a spreadsheet template for further analysis. For each included study, we extracted the study type, setting, photo application, ethical foundations, and technical elements [Fig 5]. This information was obtained from the body of the text as well as relevant figures.

#	Author	Journal/year	Study Design	Setting and photo application	Ethical element	Exposure (ISO and shutter speed)	Lighting (external on camera flash and ring flash)	Lens (focal length and depth of field)	Camera distance from the patient	Patient positioning & framing	Background usage
1	Hexsel et al.	International Journal of Dermatology / 2017	Published invalidated standards	Clinical practice Research procedural in Dermatology	-Backup file. -External hard disk.	-Manual adjustment of ISO and shutter speed.	Artificial – above the patient			-Floor and wall marks for consistency -Tripod mandatory -3 to 4 photos of the same position -Attach identification tag to the patient that is readable on the photograph **Face:** -No earrings or make-up. -Using hair cap over hairline. -Leaning against the wall. -Frontal; between hairline and chin (relaxed and contracted facial muscles). -Lateral; nose is aligned with the malar eminence. **Neck:** -Between lower lip and middle of the chest. **Chest:** -Between collarbone and	Black Green Blue Gray

										middle of the breasts **<u>Abdomen:</u>** -Between the breasts and the iliac crest **<u>Upper extremity:</u>** -Between shoulder and the tips of wrist joint **<u>Hands:</u>** -Between head of ulna and the fingertips **<u>Buttocks:</u>** -Crossing arms and placing them against the chest or the wall -Between iliac crests and the gluteal fold	
2	Persichetti et al.	Aesthetic Plastic Surgery / 2007	Report of published invalidated guidelines outside a photographic studio	Plastic surgery clinical practice		Automatic ISO. Automatic white balance.	External flash or environmental light. On camera flash → horizontal photos. Ring flash → vertical and macro photos.	Regular: 35-70 mm. Target is < 8 cm in size; use Macro Lens.	More than 1 m from the patient	**<u>Face:</u>** -No jewels, glasses, hearing aids or makeup. -Hair not to cover the face. -Frankfurt plane is always horizontal. -No smile, relaxed facial muscles. -Frontal; from the upper limit of the head to the jugular incisures. -Oblique "RT & LT"; body is rotated 45 degree	-Even non reflective. -White, black, blue, green. -Patient is placed 50 to 90 cm from the background.

										and tip of the nose is aligned with the cheek. -Lateral “RT & LT”; body is rotated 90 degree and tip of the nose is aligned with the chin. **<u>Nose:</u>** -Frankfurt plane is always horizontal -Frontal; between the hairline and the laryngeal prominence. -Oblique “RT & LT”; body is rotated 45 degree and tip of the nose is aligned with the cheek. -Lateral “RT & LT”; body is rotated 90 degree and tip of the nose is aligned with the chin +/- smiles. -Basal; head is bent backwards; nasal tip is aligned with medial canthi. -Cephalic; eyebrows aligned horizontally. **<u>Eyelids:</u>** -Frontal; from the upper limit of the head to the	

										jugular incisures. -Frontal macro; from eyebrows to the malar arches, including lateral canthi [closed & opened eyes, looking up & down]. -Oblique macro "RT & LT"; body is rotated 45 degrees [closed & opened eyes, looking up & down]. -Lateral "RT & LT"; body is rotated 90 degrees. **Ear:** -Frontal; from the upper limit of the head to the jugular incisures. -Posterior; -Lateral "RT & LT"; body is rotated 90 degrees; ear is parallel to the nose. -Oblique "RT & LT"; body is rotated 45 degrees. **Breasts:** -Frontal; from clavicles & shoulders to Ant superior iliac spines [with arms and hands behind the body, hands over head,	

										hands on flanks] -Oblique “RT, LT”, body is rotated 45 degrees. -Lateral “RT, LT”, body is rotated 90 degrees. **Hands:** -Wrist dorsal & volar -Fingers dorsal & volar [adducted / abducted / clenched fist / third, fourth & little fingers extended] **Abdomen:** -Frontal; from the infra-mammary folds to upper 2/3 of the thighs [arms & hands behind the back / raised over the head] +/- Valsalva. -Oblique “RT, LT”, body is rotated 45 degrees +/- Valsalva. -Lateral “RT, LT”, body is rotated 90 degrees +/- Valsalva. **Posterior trunk:** -From neck’s lower line to buttocks’ upper limit. **Flanks and thighs:** -From umbilicus to the	

										knees. -legs adducted / abducted. -Frontal. -Anterior oblique "RT, LT". -Lateral "RT, LT". -Posterior oblique "RT, LT". -Posterior [patient on tiptoe / contracted gluteal muscles] **<u>Legs and feet:</u>** -From the patella, and toe tips. -Legs adducted. -Frontal. -Lateral "RT, LT". -Posterior.	
3	Burns et al.	Australian health review / 2013	Mixed methods study (167 surveys to doctors and nurses. 8 interviews with clinicians)	Anesthesia department. Intensive care unit. Emergency. Surgery. Ophthalmology. Obstetrics & Gynecology. Urology. 87.5% of clinicians use photos for medical files. 51.2% of	**<u>Consent:</u>** 61% of clinicians get consents (mostly verbal). **<u>Camera:</u>** 81.2% use hospital cameras. 7.5% use personal cameras. 10% use cell-phones cameras.						

				clinicians use photos for education and teaching. Documentation. Wound tracking. Publication. Telemedicine. Personal records and patient memories.	**Record management:** 33.8% place a sticker on the photography with patient's name and date. Majority store the photos at the hospital hard-drives or files. Minority store the photos on personal devices such as cell-phones, personal computers. and memory sticks. **Copyright:** 65% did not know about the copyright.						
4	Kunde et al.	Australasian journal of dermatology / 2015	Survey (15 dermatology registrars)	**Dermatology:** Treatment. Disease-monitoring. Gain advice from peers or consultants.	**Texting and emailing:** 92% text and email photos to other colleagues. 54% disclosed to the patient the identity of the 3rd party with whom						

					they share the photos. **Consent:** 92% verbal consent. **Equipment:** 23% use extra security on the equipment used to take photos. **Patients:** 85% had experienced patients sharing images with them prior to consultation.						

Figure 5: Data extracted from included studies

4.4.6 Synthesis design

Data-based convergent synthesis design was applied in our review; because the syntheses do not depend on the results of each other and the data were synthetized in a complementary manner [Fig 6]. Results from the four studies included in the review were analyzed using the same synthesis method. Also, the results of the synthesis were presented together in the results section. In this synthesis design, we used qualitative synthesis methods to analyze all the facts. This method is inductive qualitative thematic synthesis. Then, the results of all studies were transformed into themes such as elements, concepts and factors that were further explored to yield subthemes. Themes were reported and discussed in a transparent manner.

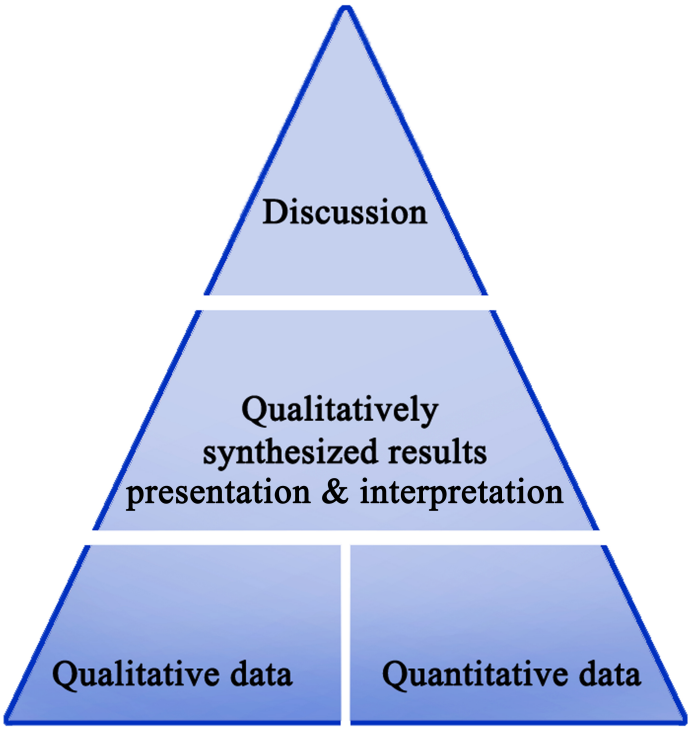


Figure 6: Synthesis method

4.5 Results

Ten main themes emerged from the four studies selected in this review [5, 19-21]. They include (1) camera exposure; (2) lighting used; (3) optical lens; (4) background; (5) camera position; (6) patient position and image frame; (7) consent; (8) copyright; (9) equipment ownership; (10) after production image storage and management. These themes were further analyzed into subthemes [Fig 7].

4.5.1 Technical elements

4.5.1.1 Exposure

It is recommended to use the "P" mode integrated in DSLR cameras. This mode permits the camera to regulate the white balance and the sensor sensitivity "ISO" according to the flash and light exposure [5]. A 2017 study showed that it is better to master manual adjustment of the ISO, white balance, shutter speed and diaphragm aperture [19]. Additionally, a tripod use is mandatory in case of slow shutter speed [19].

4.5.1.2 Lighting

In the literature, it is controversial how to achieve light standardization. Hexsel et. al showed in their study that natural available light is not recommended to be used [19]. However, Persichetti and their team indicated in their article that environmental illumination could be used as a substitute to an external fixed light source [5].

When a fixed light source is used, it is recommended to add a diffuser [5, 19]. Diffusers allow homogeneity of the light; which does not impair the skin color, or alternations [5, 19].

Persichetti and colleagues recommended a set-up of a photography studio where fixed cold lights are used; two light sources are positioned at 45 angles with respect to the

patient position [5]. Additionally, a single ceiling light source should be placed in a sagittal plane above the patient along with a light behind the patient to separate him / her from the background [5].

Out of studio photography, a fixed light source "Speedlight flash" should be used in harmony with camera position and lens, to avoid shadows [5]. Above-camera flash is used in most horizontal photographs [5]. On the contrary, vertical photos could be taken by turning the above-camera flash or by using a lens-mount ring flash [5]

4.5.1.3 Optical lens

Focal length of the human eye is 50 mm, which allows an undistorted photograph. Therefore, a 35 to 70 mm optical lens is preferred in medical photography [5]. However, to photograph smaller than 8 cm sized objects, it is recommended to use a macro lens [5].

4.5.1.4 Background and camera position

In clinical photography, using a background is a must. It must be homogenous and non-reflective. However, published studies do not agree on the same background color. The most recent published study by Hexsel et al recommended asking the patient to lean back against the background [19]. The latter should be dark colored such as black, dark gray, green or dark blue; which allows replicating the same shades whenever needed [19]. On the other hand, a study by Persichetti et al showed the importance of using light colored backgrounds such as white or light blue [5]. Additionally, a minimum distance of one meter is needed between the patient and the camera without a need of using a tripod [5].

4.5.2 Patient positioning and framing

4.5.2.1 Face

It is recommended to remove all jewelry and makeup. Hair should be tied away from the face or covered using a hair cap [19]. Two photographs with all facial positions must to be taken while facial muscles are relaxed and also contracted [5, 19]. Frankfurt plane; which is an imaginary line connecting both right and left tragions and passing by the lower edge of both orbits, should be held horizontal in all face photographs [5].

a) Entire face; is photographed frontally, laterally, and obliquely as well.

- Frontal picture is suggested by Persichetti and their team to be framed from the hairline to jugular incisures with the patient looks straight ahead [5]. However, Hexsel et al recommended framing frontal facial photos between the hairline and the lower chin edge [19].
- Oblique picture is to be taken from both right and left side as well. The whole body is turned 45 degrees and the patient is asked to look straight ahead to the camera. The nasal tip should be brought into line with the malar prominence [5, 19].
- Lateral picture is recommended to be photographed from both right and left facial sides with no visualization of the contralateral eyebrow [5, 19]. Patient's body must be rotated 90 degrees so as to align the tip of the nose with the chin [5].

b) Nose; should be photographed frontally, obliquely, laterally, and cephalically [5].

- Frontal picture is suggested by Persichetti and their team to be framed from the hairline and the laryngeal prominence [5]. The nose must be perpendicular to the Frankfurt plane [5]. Hexsel et al recommended to frame the frontal nasal view between the eye brows and the rima oris [19].

- Oblique picture must be captured from both right and left sides. The whole body is turned 45 degrees with aligning the nasal tip with the malar prominence [5]. The superior border of the view is the hairline, and the lower border is the prominence of the larynx [5].
- Lateral picture must be captured from both right and left sides; including the ear with and without a smile [5]. To insure a correct facial position, contralateral eyebrow should not be visualized [5]. Patient's body must be rotated 90 degrees so as to align the tip of the nose with the chin and the forehead [5].
- Cephalic and basal pictures are captured to assess nasal deviation and nostrils. To photograph basal view of the nose; nasal tip should be aligned with medial canthi horizontally [5]. In a cephalic view, eyebrows are aligned horizontally while the photo is being taken from above [5].

c) Eyes and eyelids; should be photographed frontally, obliquely, laterally.

- Frontal picture is suggested by Persichetti and their team to be framed from the upper limit of the head to the jugular incisures [5]. Therefore, disproportionateness and eyelids' lines could be evaluated. However, a detailed photograph is also needed to assess eyes and eyelids mobility. Upper limit of a close-up view is the eyebrows, while the lower boarder is the malar arches. Furthermore, Hexsel et al suggested framing the eyes' frontal view between the hairline and the nose tip only to photograph a detailed image [19].
- Oblique picture is to be taken from both left and right sides. It is only recommended to photograph a close-up view with closed and opened eyes while the patient's body is turned 45 degrees [5].

- Lateral picture is to be photographed from right and left sides. Persichetti et al recommended a close-up view while patient's body is at 90 degrees [5]. This view allows a thorough assessment of the eyeball in relation to the zygomatic bone [5].

d) Ears; should be photographed frontally, obliquely, laterally and posteriorly.

- Frontal picture is suggested by Persichetti and their team to be framed from the upper limit of the head to the jugular incisures [5]. Therefore, position and unevenness of the ears could be assessed [5].
- Oblique picture is to include both ears separately. Patient is asked to rotate 45 degrees. The nasal tip should be brought into line with the malar prominence [5].
- Lateral picture is to be photographed from right and left sides. Persichetti et al recommended a close-up view of the ear while patient's body is at 90 degrees [5]. To insure a right facial position, vertical ear axis is parallel to the nasal outline. This allows a detailed evaluation of all ear structure such as helix, antihelix, tragus, and ear lobule [5].
- Posterior picture is mandatory in ear assessment to measure the width of auricular-cephalic angle [5].

4.5.2.2 Neck

Hexsel and their team suggested photographing the neck area between the lower lip and the middle of the chest while the patient is looking straight ahead [19]. This allows full examination of the patient's neck. It is recommended to take two photo-sequences; one with relaxed neck muscles and another image with contracted platysmal bands [19].

4.5.2.3 Chest

a) Upper chest; should be photographed frontally.

- Frontal picture is suggested by Hexsel and their team to be framed from the clavicle and the mid-breasts level [19]. Moreover, photographs should be taken when pectoral muscles are relaxed and contracted as well [19].

b) Breasts; should be photographed frontally, obliquely and laterally.

- Frontal picture is recommended by Persichetti and their team to be framed between the clavicles and the line passing between the anterior superior iliac spine (ASIS) [5]. They also mentioned that three-sequenced photographs are mandatory for a full breast evaluation [5]. Firstly, arms are relaxed behind the back, with one hand holding the other. This position allows assessment of breast contour, size and symmetry [5]. Secondly, arms and hands are raised above the head; which permits evaluation of the inframammary folds' symmetry [5]. Thirdly, patient is asked to have both hands on both flanks while pectoral muscles are contracted [5]. This position helps assessing any pathological lesions attached to underlying fascia, and the location of any implants as well [5].
- Oblique picture must be taken from both sides which permits a relative evaluation of each breast [5]. Patient is asked to rotate 45 degrees with the area between the upper shoulder and the ASIS is being photographed [5].
- Lateral picture is to be photographed from right and left sides, which allows a separate evaluation of each breast [5]. Patient is asked to turn their body 90 degrees with one breast hiding the other one. Anatomical frame is the same as for the oblique view [5].

4.5.2.4 Trunk

a) Abdomen; should be photographed frontally, obliquely and laterally.

- Frontal picture is suggested by Persichetti and their team to be framed between the inframammary fold, and the line between the upper third and lower two third of the thighs [5]. Three frontal photographs must be taken in sequence. Firstly, with arms and hands behind the back, secondly with arms and hands above the head, and thirdly with a Valsalva maneuver. These three positions allow clinicians to assess abdominal asymmetry and hernias [5]. Hexsel et al recommended a different frame for a frontal abdominal photograph [19]. The focused area must be in between the inframammary fold and the ASIS level [19].
- Oblique picture is to be taken from right and left sides framed the same way as the frontal view. Patient is asked to rotate his / her body 45 degrees [5].
- Lateral picture is to be photographed from right and left sides framed between the inframammary fold, and the level of the upper third and lower two third of the thighs, while patient's body is rotated 90 degrees [5]. Persichetti et al recommended three different views of the abdomen [5]. First view, with a relaxed abdomen. Second view is to be taken during a Valsalva maneuver. Third view is to be taken with a bent trunk more than 45 degrees. The latter allows clinicians to evaluate musculo-aponeurotic relaxation of the lower abdominal quadrants [5]. Hexsel and their team recommended photographing the lateral view between the inframammary fold and the ASIS level with the patient's body rotated 90 degrees [19].

b) Posterior trunk; should be photographed posteriorly only.

- Anatomical points are the neck's lower limit and buttocks upper limit [5]. Hexsel and their team suggested the same frame as the frontal abdominal view but posteriorly [19].

4.5.2.5 Upper limb

a) Arms; should be framed between the shoulder and the wrist joint.

- It is recommended by Hexsel et al to photograph the arm and the forearm in three different positions. Firstly, with extended arm at a 45-degree angle from the body. Secondly, extended arm at a 90-degree angle from the body. Finally, flexed elbow view should be photographed vertically [19].

b) Hands;

- Hexsel et al recommended framing the hand between the ulnar head and the finger tips, in positions required by the surgeon [19]. However, Perschetti and their team suggested photographing the hand including the wrist, metacarpophalangeal joints, and fingertips in two different views; dorsal and volar. They also advised to have the fingers adducted and abducted as well in both views [5]. Additionally, photographing a clenched fist along with a sequence image of the third, fourth and little fingers extended is encouraged in particular cases [5].

4.5.2.6 Lower limb

a) Thighs;

- Photograph should be vertically framed between the iliac crest and the knee [19]. Hexsel and their teams recommended photographing thighs in three different positions; posterior straight, posterior oblique and lateral as well [19].

Persichetti et al recommended including the umbilicus as an upper limit of thighs photographs [5]. They reported five positions with different views to fully examine the thighs. These views include frontal (adducted and abducted legs), posterior (relaxed thighs, tiptoed patient, and contracted gluteal muscle), anterior oblique (right and left), posterior oblique (right and left), lateral (right and left) [5].

b) Buttocks;

- Hexsel et al suggested focusing on the area between the iliac crest and the gluteal fold horizontally [19].

c) Legs and feet;

- It is suggested by Persichetti et al that the focused area should extend from the patella superiorly and the toe tips inferiorly [5]. Views include frontal, posterior and lateral while the patient's legs are adducted [5].

4.5.3 Ethical elements

4.5.3.1 Consent "written vs verbal"

Burn et al showed that 46 of 70 clinicians who photograph patients obtain verbal consent, while 11 clinicians get written consent [20].

Kunde et al showed that 10 of 13 dermatologists obtain verbal consent, with only two routinely record in the medical file that they had obtained verbal consent [21].

4.5.3.2 Copyright

Burn and their team showed that less than half of medical photography users understood that the copyright is owned by the healthcare facility [20]. However, 65% of

clinicians were either unaware of the copyright or thought they own the image copyright themselves [20].

4.5.3.3 Equipment ownership

Burn's study showed that most clinicians use facility owned equipment when available [20]. However, they tend to use their personal cellphones for easier approachability and user-friendliness [20]. A study conducted by Kunde et al in 2013 on 13 dermatology registrars, showed that all clinicians use their cellphones for photographing patients [21]. All of them reported storing patients' photos on their phones [21].

4.5.3.4 Data management

Burn's study indicated that 27 of 80 clinicians placed a sticker on the back of the print-out photograph including date, and purpose of the image [20]. Most physicians stored soft copied of photographs in the facility database [21]. A few used to keep copies on their personal devices such as computers, hard drive or flash memories [20].

Kunde et al showed that all surveyed dermatology consultants, send patients' photos via emails and text messages either for advice or second opinion [21]. More than half of dermatologists reported disclosing patients' identity to a third party when sharing patients' photos [21].

Hexsel and their team stated that backup image files should be always stored on encrypted external hard drives [19].

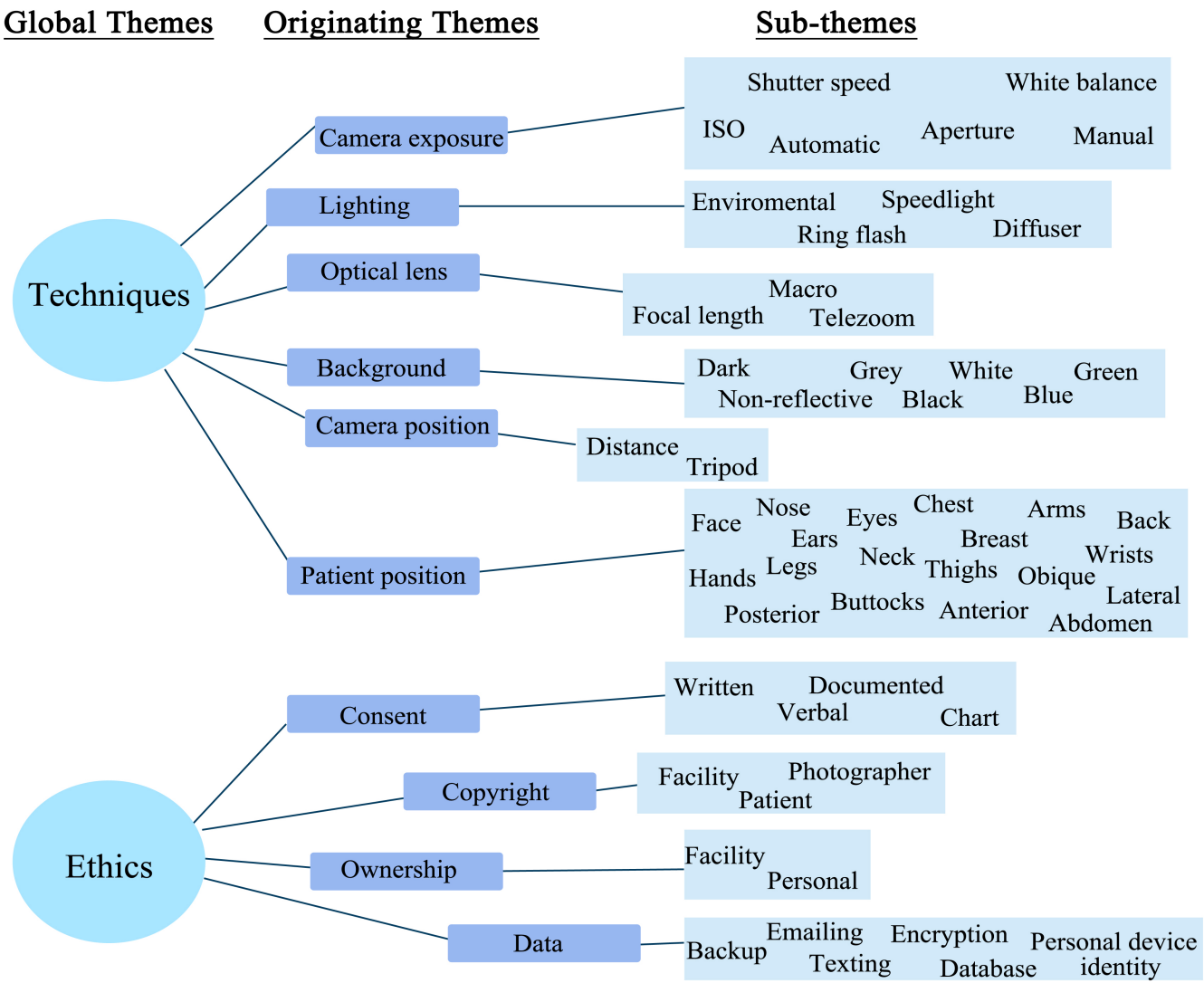


Figure 7: Thematic analysis

4.6 Discussion

A few studies have reported opinions to establish standards for medical photography. However, no study had shaped a validated guideline to support medical photography users. This article presents themes that seem important in creating a customary best-practice. We focused on two main global themes; which are technical skills and ethical consideration.

Digital photography has become an extremely important element of medical care nowadays. Just as computers, tablets, computer-based programs, smart phone apps, and other technological advances that assist physicians, photography is evolving rapidly, and a good use of this tool is both a perceived and unperceived need in the continuous professional development of physicians. Developing a guide to properly craft an image may enhance the care provided by clinicians [4]. Additionally, it will facilitate medical teaching approaches to in-training residents and physicians as well as medical research and publications.

In the era of photochemical film based cameras, a photograph was fabricated by light falling on the film and then printed at a lab using special equipment and illumination [6]. Today, an image is produced and stored electronically, when a light falls on a digital camera sensor in less than a second [11]. Ideal camera resolution to be used in clinical practice is at least 16 megapixels [6]. Digital Single Lens Reflex (DSLR) cameras are known for their large sensors; which are capable of capturing enough photons for sharper images with less graininess [22].

In these camera systems, exposure is controlled by shutter speed, aperture and ISO. Shutter speed demarcates the duration the lens shutter opens to allow enough light to touch the camera sensor [10]. Slow shutter speed with no camera support (tripod), could produce a camera shake and thus a blurry photo [12]. Therefore, in medical photography, shutter speed should be equal to the inverse of the lens focal length [12]. When adjusting a lens focal length to 70 mm,

shutter speed should be 1/70 sec.

Aperture is the lens opening size and is calculated in f-stops. It is responsible for the depth of field – image layers' sharpness [23]. The higher the f-stop, the greater the depth of field [24]. For a sharp image, f-stop should be between f8 and f22 [16, 24].

ISO controls the sensor sensitivity level to light. In the last 15 years, camera sensitivity to light had been increased with minimum effect to the image quality [6]. With today's DSLR camera systems, ISO can reach as high as 204800, which allows a photographer to shoot and produce a good sharp image in an extraordinary low light availability [6]. However, the more the ISO level, the more the graininess. For a less-noisy photograph, ISO should not exceed 400 [6].

Light used in medical photography is a topic of controversy. A few authors agree on using available daylight which is easier for clinicians to use [5, 6]. Although it produces natural skin tone, it lacks standardization. Other studies showed that artificial external light source is a must when it comes to medical photography [19, 22, 25]. However, it needs a basic level of training to be able to adjust an external flash and camera settings accordingly. In case of using a camera in operating theaters, it is desirable to use available light in operating rooms along with an external flash with a diffuser [6].

Medical photographs are considered an integral part of a patient's file and must always be protected [26]. Copyright ownership usually allows the owner to replicate the image he / she takes, engage the photograph in presentations, dissemination, and exhibitions freely [27]. Photographic copyright is typically owned by the person who photographs the patient [28]. However, under federal and provincial privacy laws, a photographer is restricted by patient's confidentiality protection, and privacy release consent is usually required [28]. Therefore, patient's permission is necessary before using his/her photo out of the direct medical care [29].

Medical images must be stored as encrypted files in the healthcare facility database [4].

It is mandatory to obtain an informed written consent from the patient before taking a photo [25]. Moreover, consents are advocated to include a statement explaining that the photographs are part of the medical record and could be used for educational purposes and publications [30]. Additionally, a consent form should clearly state that photographing the patient is a low-risk procedure, and the only harm that could affect them is the time required for the photography session [4]. Patient's agreement must be given voluntarily with no effect on clinical care should the patient refuse to give permission [4, 25].

In 2016, journals' guidelines were reviewed by Robert et al. regarding patients' de-identification [31]. They showed that written consents are required to publish identifiable photos [31]. However, it is recommended to mask the eyes and eyebrows whenever possible [32]. In case of unidentifiable photos, journals and scientific conferences habitually do not require signed written consents [31]. They claim that capturing a non-identifiable photo decreases the potential for recognition and privacy breaching [31, 33]. Nevertheless, removing all recognizing features of the patient is not always sufficient to conceal patient's privacy; because the pathology itself could provide a well-defined detection [33].

Literature proposes four techniques to de-identify a patient's face via whichever available computer-based photography software; (1) replacing the eyes and eyebrows with skin from a nearby area such as cheeks or forehead (skin cloning) [34]; (2) using a smudging brush to blur the eyes and eyebrows [35]; (3) adding a layer with a black rectangle over the eyes region [36]; (4) pixilation of the eyes area [31].

Medical photos are part of the medical charts, which are owned by the healthcare facility. Therefore, photographs must be captured by a facility-possessed camera and stored in a facility-

controlled database [20]. Inappropriately, cellphone technology has been playing a progressively prominent role in the medical field over the last few years [37]. Clinicians tend to use their smartphones for clinical photography; to be used for different purposes [38]. The latter includes clinical care, education, documentation and publication. It is not recommended to use a personal device to take and/or store patients' photos so as to protect patient's privacy [37]. Moreover, camera sensors in smart phones are not capable of capturing a well-adjusted photograph that is satisfactory for clinical use. Also, the automated system built in this kind of cameras is very restrictive and does not allow users to control camera exposure, depth of field, or lighting. Therefore, it is impossible to standardize a photo using a cellphone-attached camera [38].

4.7 Conclusion

Medical photography progressed from film-based cameras with full manual adjustments to digital cameras with complete automated functions. Being knowledgeable about the main technical and ethical elements in photography is important for physicians using this technology. A minimum degree of training and practicing is needed to master photography skills. Additionally, an easily applicable best-practice guide is required to further assist clinicians. Our review highlights principal themes that show a definite potential for a properly-crafted and verified guideline.

4.8 Acknowledgment

We acknowledge our librarians at The McGill University Health Centre: Ms. Elena Guadagno, Mr. Alex Amar and Ms. Taline Ekmekjian for their assistance in performing the literature search. Also, we would like to acknowledge Dr. Coralie Vachon for her assistance in reviewing and screening articles' titles, keywords, and abstracts.

References

1. Hubbard VG, Goddard DJ, Walker SL. An online survey of the use of digital cameras by members of the British Association of Dermatologists. Clin Exp Dermatol. 2009; 34 (4):492-494.

2. Taylor D, Foster E, Dunkin CS, Fitzgerald AM. A study of the personal use of digital photography within plastic surgery. J Plast Reconstr Aesthet Surg. 2008; 61 (1):37-40.

3. Brown MS, Jindal V, Rubin PA. Digital photography for the ophthalmic plastic surgeon. Ophthal Plast Reconstr Surg. 2001; 17:151-153.

4. Harting MT, DeWees JM, Vela KM, Khirallah RT. edical photography: current technology, evolving issues and legal perspectives. Int J Clin Pract. 2015 Apr;69 (4):401-409.

5. Persichetti P, Simone P, Langella M, Marangi GF, Carusi C. Digital photography in plastic surgery:How to achieve reasonable standardization outside a photographic studio. Aesthet Plast Surg. 2007;31:194–200

6. Peter S. Practical aspects of clinical photography: part 1 – principles, equipment and technique. Anz J Surg. 2013; 83:188-191.

7. Kontis TC. Photography in facial plastic surgery. In: Papel ID, editor. Facial plastic and reconstructive surgery. 3rd edition. New York: Thieme; 2009. P. 143-152.

8. Spear M, Hagan K. Photography and plastic surgery: Part 1. Plast Surg Nurs. 2008; 28:66–70.

9. Ellenbogen R, Jankauskas S, Collini F. Achieving standardized photographs in aesthetic surgery. Plast Reconstr Surg 1990; 86 (5):955e61.

10. Galdino GM, DaSilva D, Gunter JP: Digital photography for rhinoplasty. Plast Reconstr Surg. 2002; 109:1421–1434.

11. Peck JJ, Roofe SB, Kawasaki DK. Camera and lens selection for the facial plastic surgeon. Facial Plast Surg Clin North Am. 2010; 18:223-230.

12. Galdino GM, Vogel JE, Vander Kolk CA: Standardizing digital photography: it's not all in the eye of the beholder. Plast Reconstr Surg. 2001; 108:1334–1344.

13. May M. Photography for the physician. 1. A medical photographic set up. Eye Ear Nose Throat Mon. 1972(1); 51:28-32.

14. Goerig AC, Hourigan MJ. A practical approach to clinical photography (II). Quintessence Int Dent Dig 1982(a); 13:679-684.

15. Nayler JR: Clinical photography: a guide for the clinician. J Postgrad Med. 2003; 49: 256–262.

16. Stack LB, Storrow AB, Morris MA, Patton DR. Handbook of Medical Photography. 1st Ed. Philadelphia, PA: Hanley & Belfus Inc. 2001; P 469.

17. Hagan KF. Clinical photography for the plastic surgery practice-the basics. Plast Surg Nurs. 2008; 28:188-192.

18. Langford M, Bilissi E. Image sensors. In: Langford M, Bilissi (Editors). Langford's Advanced Photography. 7th Ed. Amsterdam, The Netherlands: Focal Press. 2008; P 108-128.

19. Hexsel D, Hexsel CL, Dal'Forno T, Silva AF, Siega C. Standardaized methods for photography in procedural dermatology using simple equipment. Int J Derma. 2017; 56:444-451.

20. Burns K, Belton S. Clinicians and their cameras: policy, ethics and practice in an Australian tertiary hospital. Aust Health Rev 2013; 37:437.

21. Kunde L, McMeniman E, Parker M. Clinical photography in dermatology: Ethical and medico-legal considerations in the age of digital and smartphone technology. Aust J Derma. 2013; 54:192-197.

22. Swamy R, Most S. Pre- and postoperative portrait photography: standardized photos for various procedures. Facial Plast Surg Clin N Am. 2010; 245-252

23. Taheri A, Yentzer B, Feldman S. Focusing and depth of field in photography: application in dermatology practice. Skin Research and Tech. 2013; 19:394-397.

24. McKeown HF, Murray AM, Sandler PJ: How to avoid common errors in clinical photography. J Orthod. 2005; 32: 43–54.

25. Archibald DJ, Carlson ML, Friedman O. Pitfalls of nonstandardized photography. Facial Plast Surg Clin North Am. 2010; 18:253-266.

26. Scheinfeld N. Photographic images, digital imaging, and the law. Arch. Dermatol. 2004; 140:473-476.

27. The U.S. Copyright Act at 17 U.S.C. 106 (http://www.copyright.gov/title17/92chap1.html#106)

28. Wright CE. An interview with Carolyn Wight of www.photoattorney.com, Photography and copyright law (Part I), In: Kaminesky K, ed. (http://blog.kenkaminesky.com/photography-copyright-and-the-law/)

29. Pace N, Hendry R. Consent: ethical considerations. Anaesth. Intensive Care Med. 2006; 7:107-110.

30. Segal J, Sacopulos MJ. Photography consent and related legal issues. Facial Plast Surg Clin North Am. 2010; 18:237-244.

31. Robert E, Troiano C, Spiegel J. Standardization of guidelines for patient photography deidentification. Ann Plast Surg. 2016; 76:611-614.

32. Jones B. Ethics, morals and patient photography. J Audiov Media Med. 1994; 17:71-76.

33. Smith R. The digital camera in clinical practice. Otolaryngol Clin N Am. 2002; 35:1175–1189.

34. White M. Removing eyebrows impairs recognition of famous faces, or doesn't, depending on

how the eyebrows are removed. Perception. 2004; 33:1215-1220.

35. Engelstad M, McClellan M, Jacko J, et al. Deidentification of facial images using composites. J Oral Maxillofac Surg. 2011; 69:3026-3031.

36. Slue WE. Unmasking the lone ranger. N Engl J Med. 1989; 321:550-551.

37. Chan N, Charette J, Dumestre DO, Fraulin FO. Should 'smart phones' be used for patient photography? Plast Surg. 2016; 24:32-34.

38. Payne K F, Tahim A, Goodson A Mc, Delaney. A review of current clinical photography guidelines in relation to smartphone publishing of medical images. J Visual Communication in Medicine. 2013; 35:188-192.

CHAPTER FIVE: Qualitative Study

ABC Camerawork Guide for Dr. Photographer: An Exploratory Qualitative Study

Farid F Ibrahim [a, b], MD; Gillian Bartlett [b], PhD; Sam J Daniel [a], MD

[a] Department of Otolaryngology-Head and Neck Surgery, The Montreal Children's Hospital, McGill University, Montreal, QC, Canada

[b] Department of Family Medicine, McGill University, Montreal, QC, Canada

Keywords: clinical, photography, digital, techniques, ethics, medical

Running Head: Interviews About Principles of Medical Photography

Contribution of authors:

Farid F Ibrahim contributed to the design of the study, conducting interviews, data collection, analysis and interpretation, and drafting the manuscript.

Gillian Bartlett contributed to the design of the study, conceptualization of the research question, and critical revision of the manuscript draft.

Sam J Daniel contributed to the design of the study, conceptualization of the research question and objectives, and critical revision of the manuscript draft.

Authors in Order:

Farid F Ibrahim
Department of Family Medicine – Medical Education
Department of Otolaryngology – Head and Neck Surgery
McGill University

The Montreal Children's Hospital, McGill University
1001 Boul Decarie
Montreal, QC H4A 3J1
farid.ibrahim@mail.mcgill.ca

Gillian Bartlett
Department of Family Medicine
McGill University

5858, chemin de la Côte-des-Neiges, Suite 300
Montréal, QC H3S 1Z1

gillian.bartlett@mcgill.ca

Sam J Daniel
Department of Otolaryngology – Head and Neck Surgery
McGill University

The Montreal Children's Hospital, McGill University
1001 Boul Decarie
Montreal, QC H4A 3J1
sam.daniel@mcgill.ca

Linking statement

Manuscript one that was written based on a systematic review enabled us to thematically analyze and present the results in a transparent way; which facilitated the explicit production of important concepts. Results of this review showed the need for an applicable best-practice guide and the potential of creating a fruitful one that could aid physicians in using cameras in their examination rooms.

Produced concepts were used to construct an interview guide that was the corner stone of a qualitatively designed study. The study, which follows, aimed to further explore important medical photography elements and to develop a medical photography guide.

5.1 Abstract

Introduction:

Photographs are commonly taken in medical contexts. Although automated camera systems are very user-friendly, it is still technically challenging to reach a standardized photograph. Moreover, appropriate utilization of digital images within the medical practice has not always been uniformly agreed upon. Therefore, the aim of this exploratory qualitative study was to investigate experts' recommendations for health professionals utilizing digital photography.

Methods:

Qualitative description methodology was used in this study. This methodology is a comprehensive summarization, in every term of a specific topic - medical photography, experienced by individuals - medical photographer. It was used to gain an understanding of underlying opinions and to provide insights into the aforementioned topic that were applied to develop a guideline.

Results:

Photographs are a valued resource in the medical practice but a doctor photographer needs to be mindful of how they are crafted and utilized in a proper and meaningful way. Selecting the appropriate equipment and handling it in a professional manner is necessary when taking photographs. Additionally, obtaining an informed consent and concealing the patient's identity should be considered in medical photography sessions. Our interviews result in techniques to capture an image in a professional way without breaching patient's privacy.

Conclusion:

This study initiated the inception of a best practice guide that handles important technical and ethical parameters of medical photography using digital cameras. Further research is recommended to test and validate this guide.

5.2 Introduction

In the health sector, camera usage has been increasing over the last years. This practice has improved since the first introduction of digital single-lens reflex (DSLR) camera systems [1]. However, many healthcare facilities do not employ skilled photographers any longer because of the extra cost and the increasing simplicity of camera technology [1]. Therefore, clinicians and surgeons including residents and fellows in training are required to produce photographs themselves [1]. This decreases the patient's waiting time if the image is captured by a doctor photographer who is trained to get a viable shot [2]. Inexpensive camera set-ups, as well as the ability to assess photos instantly on a camera attached high definition (HD) screen have reduced the learning period needed for photography and made it leisurelier for healthcare providers [2, 3]. Nevertheless, in addition to good technology, training to a standard procedure is required [4].

Medical photographs are advantageous for clinical management, documentation, education, research, and publications and to support medico-legal cases [5-7]. Therefore, a standardized photograph is fundamental in the medical practice. Standardization requires unchanged focal length, lighting set up, aperture, shutter speed, international standards organization (ISO), background, and patient positioning [8, 9]. Furthermore, it includes formal consent of patients by obtaining a written permission before capturing the photograph. This consent should be given voluntarily after a thorough discussion about the reasons for the photograph, how it will be used, and the harm that could possibly occur [10]. It is also crucial to explain and document that consent may be withdrawn at any time without any negative implications [10].

The choice of equipment is a very important step towards a standardized photo. It depends on the camera sensor, lens, and proper light source [7]. Wide sensors are always

preferred in medical photography. They have the advantage of capturing more detailed photos with less noise [11]. The best DSLR camera system is equipped with a full-frame sensor. This type of sensor is wider than the regular Advanced Photographic System Type C (APS-C) sensor; which is manufactured for regular DSLR cameras. A full frame sensor measures 24 mm x 36 mm, and is capable of photographing high quality images even in low light exposure. On the other hand, compact cameras and smart phone cameras are known for their small sensors and built-in lenses. Therefore, it is almost impossible to control the focal length and shoot a standardized photograph with one of the aforementioned cameras [11].

Literature is not consistent when it comes to camera lens, and lighting source used in medical photography. It also lacks knowledge concerning a calibration guide for camerawork in general medical practice [12]. Different opinions and surgical-based protocols are being used nowadays with no proper validation [13, 14]. A best-practice tool should be established to construct a coherent system so as to obtain and access photographs in a professional and ethical manner. This study was conducted with the aim to explore the missing knowledge in this area and to develop an applicable guide that could be utilized by physicians.

5.3 Research question

What are the technical and the ethical foundations needed to understand modern medical photography and to develop a relevant guide for healthcare providers?

5.4 Methods

5.4.1 Study design

A qualitative description methodology was used as rationalized by Sandelowski and Neergaard within a truthful investigational hypothesis [15, 16]. A series of semi-structured in-depth interviews were conducted [15, 16]. This methodology represents the optimal choice for the research question; what are the elements needed to develop an applicable guide for medical photography?

5.4.2 Participants recruitment

A purposive maximum variation sampling technique was chosen to select a varied range of participants by age and years of experience [15, 17]. Participation in the study was voluntary and all participants provided well-informed written consents. To ensure that the measure was appropriate for assessing the needs and related issues of modern medical photography, experienced medical photographers were recruited from different healthcare facilities across the Greater Montreal area. They represented a broad diversity of ages, backgrounds, and experiences.

Identified participants were approached by either an email or a phone call. All invited participants received a letter of introduction and a consent form for the study. The letter outlined the study rationale, objectives, and estimated time commitment required [Appendix 1]. It also specified contact information for the research team so that any specific questions could be answered prior to the respondent agreeing to participate. Consenting participants were asked to return a hard copy of the signed consent form to the research team in order to be included in further communications. The study was further explained and a conjointly appropriate date, time and place for the interview were organized for the participating interviewees. Participant

recruitment continued until data saturation was reached. In total, six in-depth interviews were conducted.

5.4.3 Study setting

The study took place at the Research Institute of McGill University in Montreal, QC, Canada, under the direct supervision of the Otolaryngology – Head and Neck Surgery Department. All interviews were carried out in person – face to face, in a private meeting room. Only the researcher (FI) and the interviewee were present in the room to ensure confidentiality. All participants signed a consent form before joining the interview. Ethics approval was obtained from McGill University Health Centre (MUHC) Research Ethics Board (REB).

5.4.4 Data collection

In-depth interviews were conducted using a semi-structured interview guide consisting mainly of open-ended questions, as well as prompts, while allowing for unprepared inquiries to explore emerging issues raised during each interview [Appendix 2]. These questions were initially retrieved from a systematic review conducted by our team. Open-ended questions elicited information on technical and ethical issues of medical photography, and their relevance to construct an applicable best-practice guide.

The interviewer was directing questions while writing notes about questions that were considered difficult to understand, and any other weaknesses or flaws in the interview guide. Each interview lasted from 60 to 75 minutes and was conducted in English. All interviews were audio recorded and transcribed verbatim. Participants' names were not included in the recordings or the transcripts to ensure privacy.

5.4.5 Data analysis

Descriptive statistics were used to describe the demographics of participants, which mainly included their age, background, years of experience and areas of expertise. The comments of all interviewed participants were analyzed and compiled for further recommendations to develop an applicable guideline. More specifically, the research team used qualitative content-based analysis techniques to identify key points related to each question administered during the interview as proposed by Graneheim and Lundman [18]. Content analysis is usually used when there is not much known about the phenomenon or research topic under study. It allows the emergence of codes and categories from the research data rather than using codes from a previous theory.

Relevant quotes depicting the main elements discussed in the interview were categorized into topic areas or themes, and based on the content, conclusions were drawn. Data collection and analysis occurred simultaneously to inform any modification required for the interview guide, by emerging topics from the analysis [15].

Raw data from the interviews were sorted into three main content areas based on the use of a deductive coding frame as described by Crabtree and Miller [19]. The three content areas included: 1) *The main technical elements* needed to craft a photograph professionally, 2) *The main ethical issues* needed to be addressed while applying medical photography in clinical practice, 3) *Structural educational changes* needed to help improve physicians' photography skills. Data coding was done by the main researcher (FI) and the data analysis process was conducted manually without the use of analysis software.

5.4.6 Strategies for assuring rigour

Despite the fact that qualitative description is usually accused of lacking rigour, we intended to follow different strategies to improve accuracy in our study [16]. In order to reach

authenticity, we respected specific measures. Interviews took place privately to make sure that the participants spoke freely about their experiences and opinions. Also, purposeful maximum variation sampling ensured capturing a variety of informants' opinions. Moreover, semi-structured and open-ended questions allowed the participants to say what they considered was relevant instead of being restricted to only answering the research questions. Furthermore, transcription of the audio recordings was done word by word and the transcribed data was second validated by listening to the recorded interviews while following the transcript. Finally, qualitative content data analysis ensured that codes were being generated from the collected data and not superimposed on them [16, 20]. The credibility of our study came from adhering to the true insider interviewees' viewpoints as much as possible.

5.5 Results

A total of six photographers participated in the study, representing a broad diversity in terms of age, gender, background, and experience [Table 1]. All study participants were working as medical photographers in Quebec, Canada at the time the interviews were conducted and therefore their opinions described in this research reflect their involvements in the Canadian healthcare system. All participants had studied photography as a major educational domain, except two who had a background in videography in addition to photography. They were all considered highly experienced photographers, and were familiar with all the current formal terminology used in medical photography as well as the photography challenges facing physicians. The study findings are summarized in more details according to the three main content areas used to structure the qualitative analysis.

Table 1: Description of participants (N=6)

Gender		
1	16.7%	Female
5	83.3%	Male
Age		
0	0%	Under 30 years
2	33.3%	30 to 39 years
1	16.7%	40 to 49 years
1	16.7%	50 to 59 years
2	33.3%	60 years and older
Time since starting photography as a profession		
1	16.7%	less than 10 years
2	33.3%	10 to 20 years
3	50%	more than 20 years
Educational background		
1	16.7%	portrait photography
2	33.3%	cinematography & portrait photography
3	50%	commercial & portrait photography

5.5.1 The main technical elements needed to craft a photograph in a professional manner

According to our study participants, the principal technical element needed to perfectly capture a photograph is camera adjustment. The latter includes selecting the proper camera system, optical lens and light source, in addition to exposure control. Moreover, patient position, photographer distance and background used are considered crucial points in medical photography.

5.5.1.1 Camera system

Although the DSLR camera system is fairly new and was never formally taught to our participants at school, they all recommended it to be used in medical photography. They praised using ASP-C sensor-based cameras and full frame cameras when affordable. Most interviewees opposed using smart phones to capture photographs. A photographer clarified; "*Unfortunately, nowadays a lot of physicians take photos using their cellphones, and it cannot be called a camera. No one can take good regular photos, close-ups or even macros with a phone; the photo quality is considerably poor concerning sharpness, exposure, and colour balance. The chip is also very small compared to real cameras, and the light used is not necessarily enough for good photos. Maybe, the technology is suitable to capture special personal moments, but it cannot be used for medical purposes."*

5.5.1.2 Optical lens

All study members recommended including two lenses in medical photography equipment set. The first lens that is used predominantly should be 24-70 mm. This is a telephoto lens that tolerates different focal lengths without affecting the image quality or the sharpness. It is suggested that focal length adjustment must be consistent. One of the interviewees explained; *"The human eye sees around 40 to 50 mm. Therefore, full body can be photographed at 50 mm*

and you should not go wider because of distortion. Head, neck and shoulders could be done around 70 mm. Extended arms could be done around 50 mm."

The other lens to be included in the equipment set is a 105 mm macro lens, which allows taking close-up photos. Usually, it is needed to capture objects less than 8 cm in size.

5.5.1.3 Light source

An appropriate light source is also very important to capture a good image. All study participants insisted that only an external flash system should be used for a standardized photograph. It is not advised to depend on available light such as fluorescence or environmental. A photographer with more than 20 years of experience repeated it a few times; "*Never to use available light, never never never! This will lead to a very poor, unstandardized photo that should not be included in a medical chart."*

It is recommended to use on-camera flash (speedlight) in most cases. However, our participants warned that speedlight flash source produces harsh strong light, which might affect the image quality. Therefore, it should be bounced to the wall or the corner of the ceiling if white. In case it is not available in white colour, a soft box, an umbrella, or a diffuser ought to be used. Ring flashes that are lens mounted are great tools when it comes to macro photography or capturing cavities such as oral or vaginal.

5.5.1.4 Exposure

Exposure control is crucial to create a sharp photograph. Participants explained that exposure adjustment consists of three singular parameters that must be taken into consideration. A participating photographer stated that at photography school, exposure is taught as a triangle built of 3 major components. In her own words; *"To adjust a camera exposure, you have to remember that triangle (shutter speed, ISO, and aperture)"* [Fig 1].

Figure 1: Exposure triangle

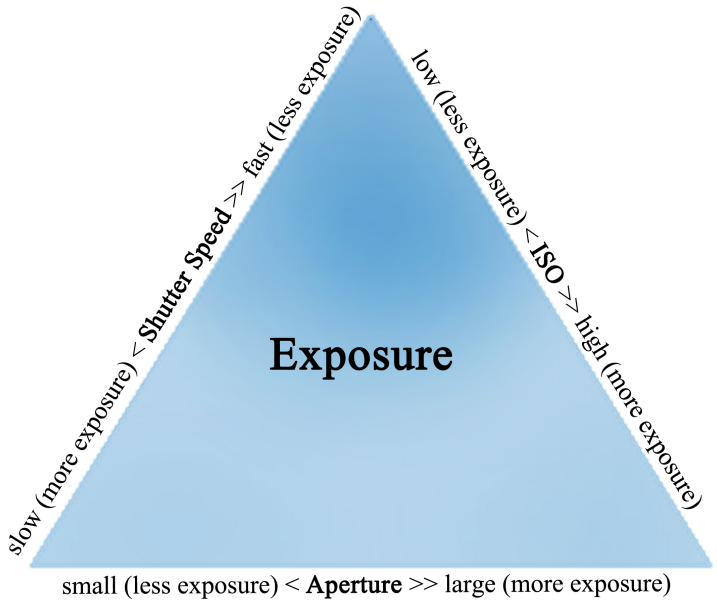


Figure 1: Relationship of shutter speed, ISO, aperture, and light exposure

a) Shutter speed controls the time for which the camera shutter is open to take the photo. High shutter speed means that the shutter is open for a short time and less light will get to the camera sensor. Low shutter speed means that the shutter is open for a longer period and more light will get to the camera sensor. Nonetheless, very slow shutter speed can result in a blurred photo because of the photographer's shaky hand or the target's movement. Interviewees explained that the minimum safe shutter speed is 1/focal length. If the focal length used is 70 mm, shutter speed should be 1/70 sec. However, they suggested that shutter speed for medical photography should be 1/double focal length. For example, in case of using 70 mm focal length, shutter speed must be at least 1/140 sec.

b) ISO controls the camera sensitivity to light. The more the ISO, the higher the sensitivity. However, the lower the ISO, the sharper the image, and thus a less grained photograph is produced. In medical photography, it is advised to adjust ISO between 100 to 400.

c) Aperture is the opening through which light travels to the sensor. It is referred to as f/number which is the ratio of focal length to effective aperture diameter. F-stop is inversely proportional, which means that the higher the number, the smaller the aperture. In other words, f/1.4 is a large aperture diameter and f/22 is a small aperture diameter. F-stop variation controls the image depth of field which is referred to as photograph plans. Large aperture such as f/4 leads to shallow depth of field and more blurred plans in the photo. Small aperture such as f/11 leads to greater depth of field and more plans in focus. In medical photography, it is recommended by our participants to adjust the aperture between f/8 to f/11; which allows having the whole target in focus. However, in case of macro photography, f-stop should be increased to 20 in order to avoid photo distortion. An interviewee explained; *"In medical photography we need to have our target sharp and focused. Therefore, f/8 to f/11 range is used and it gives you a decent depth of field. For portraits and full body shots, f/11 is enough to get the whole target in focus. Nevertheless, if you use a macro lens, you have to assess the focus and the circle of confusion that distort the photo a little bit. In such case, you might need to increase your lens f-stop to 20."*

5.5.1.5 Photographer distance

The camera should be at least three feet away from the patient. This distance depends on the chosen focal length and the target being photographed. A participant stated; *"Always remember that you have to be in a good focal distance that allows you to adjust your focal length*

and have the whole object included in the viewfinder frame. Sometimes you have to go closer to the patient and sometimes you have to get far from the patient."

5.5.1.6 Patient position and composition

Patient position is an important component when capturing a standardized photo. Firstly, patients should be situated at a decent distance from the background to avoid shadows. As explained by one of our interviewees; *"It is necessary to avoid shades in your shot. Shadows are produced when the light hits an opaque target. Controlling it is actually very easy, the closer the person to the wall or the background, the bigger the shadow you will get. You have to ask your patient to step forward from the wall until his/her shadow falls on the floor."*

For full body photographs, adult patients should be standing five to six feet away from the background. In the case of capturing children's photographs, a two to four-foot distance is usually enough to avoid shadows. Nevertheless, exam rooms do not usually allow this distance. Therefore, flashlight has to be bounced to the wall and ceiling to prevent glooms without asking the patient to change position.

Study participants explained the way they prefer to frame different medical photographs. Nevertheless, they all agreed that it is the physician's role to notify them of the exact areas needing to be captured. A photographer stated; *"During my 35-year career as a photographer, my image framing has been reliant on a discussion with the clinician who is asking me to take the photo. I also take into consideration to fill my viewfinder frame with the body part. However, first shot must have the patient's face for identification purposes."*

Framing and composition of different body parts are described as suggested by study participants:

1) Face is to be captured from five different angle views; frontal, lateral, oblique, basal and superior. Three out of the six interviewees suggested photographing all views with a smile and without a smile as well. Photographs are bordered between the hairline above and the supra sternal notch below.

2) Nose is to be captured from five different angle views; frontal, lateral, oblique, basal and superior. All nose images are framed the same way as face photos; between the hairline and the supra sternal notch. However, nose must also be photographed using a macro lens which produces a close-up detailed image.

3) Ear is to be captured from four different angle views; frontal, lateral, oblique, and back. These shots are framed between the upper limit of the head and the mandibular angle. Additionally, it is important to document a macro photograph of the ear which shows all anatomical and pathological features.

4) Eyelid is to be captured from three different angles; frontal, lateral, and oblique. It is essential to photograph these views using a macro lens. These images are bordered with the eyebrow above and the malar arch below.

5) Eye is to be captured from three different angles; frontal, lateral, and oblique. Photographs are framed between the hairline and the nasal tip.

6) Breast is to be captured from three different angles; frontal, oblique and lateral. Patient is usually asked to hold her hands behind her back. Also, it is advised to shoot the same views while the patient elevates her hands above her head and also while having both hands on her flanks. Breast photographs are crafted between the clavicle level above and the umbilical line below.

7) Hand is suggested to be documented in different ways. They include dorsal view with the wrist, volar view with the wrist, dorsal view with fingers adducted, volar view with fingers adducted, dorsal view with fingers abducted, volar view with fingers abducted, dorsal view with clenched fist, volar view with clenched fist, dorsal view with third, fourth and little fingers extended, and volar view with third, fourth and little fingers extended.

8) Forearm and elbow are photographed in different positions. These positions include dorsal and volar views of forearm and elbows while the arm is extended, side view of forearm and elbow while wrist is flexed, side view of forearm and elbow while wrist is extended.

9) Abdomen is to be photographed from frontal, oblique and lateral angles. All views are framed between the nipple line and the mid thigh level.

10) Posterior trunk is suggested to be photographed only from the back, between the posterior hairline and the mid-thigh level.

11) Flanks and thighs are recommended to be snapped from frontal, oblique, lateral and back angle views. All views should be captured in a sequence, once with abducted thighs and then with adducted thighs. They are all framed between the umbilical level and the knee level.

12) Legs and feet are photographed frontally, laterally and posteriorly. These pictures are usually framed between the knee level and the toes. However, feet must be captured separately including both plantar and dorsal surfaces.

5.5.1.7 Background

It is a must to have a clear homogenous background in all medical photos. However, in the case of photographing infants and children less than three years old, the background used is usually parents' clothes. Our study participants suggested using light-coloured backgrounds such as green, blue, light grey, or white. A photographer stated; *"I always use a background and it*

must be as clean and soft as possible. For example, a light-coloured wall, or green or blue background. In case of pediatrics, it is hard to direct the child and very often I take my shot while the child is on his/her parent's lap and I usually use the parent with plain clothes as a background. I also ask the parent to take their jewelries off if they have any."

5.5.2 The main ethical issues needed to be addressed while utilizing medical photography in clinical practice

According to the study candidates, the core ethical challenges that must be addressed while using a camera in the medical practice are consent, confidentiality, and copyright.

5.5.2.1 Consent

It is mandatory to obtain a properly documented written consent before touching a camera in a clinical or a surgical setting. A participating candidate elaborated; *"Verbal consent is not enough. Only a signed written consent that covers everything the physician needs. For example, if the patient signs only for documentation, their photos cannot be used for education or publication."*

Consent must be discussed and obtained by the physician himself / herself before photographing the patient. *"You cannot ask someone such as your student or a secretary to obtain the consent, it should be the treating physician's job after discussing it in details," said a participant.*

In case of minors who are aged below 14 years, it should be their guardians who sign the consent form. Our study participants discussed only one condition when a signed consent is not necessarily needed. This condition could be an emergency situation such as an accident with no accompanying guardian, or a suspected case of abuse.

5.5.2.2 Confidentiality

Conducted interviews showed that several techniques could be used to protect the patient's privacy and confidentiality. Photographers proposed using a code and date instead of a name while handling patient's files. Additionally, patients' photographs must be stored on two different secured databases, and must not be shared between different parties using emails or cellphone messages.

Also, they explained that equipment used for medical photography must be facility owned and not personal. Furthermore, it is important to conceal the patient's identity as much as possible. All study participants suggested cropping out the face if it is not needed in the photograph. However, masking patients' eyes, eyebrows, nasal bridge and lower half of forehead is considered sufficient to de-identify the patient, unless he / she has a very specific pathological lesion which is identifiable.

5.5.2.3 Copyright

A patient's photograph is considered part of the medical chart, which is a property of the healthcare facility. *"The photo is owned by the facility not by the photographer nor the patient. However, the patient should be entitled to receive a copy when needed,"* said a participant. Copyright is owned by the facility where the photograph has been taken. Nevertheless, reproduction, selling or distributing a patient's image without a written agreement is considered a lawful offense under the provincial and the federal law.

5.5.3 Structural changes needed to help improve physicians' photography skills

Study interviewees emphasized that the keys behind learning and improving photography skills are developing a detailed guide that could be added to medical school curricula and residency programs, in addition to continuous camerawork practice. "*Following instructions*

along with constant training are main factors to improve technical skills. You will never master any photography techniques by keeping the camera in your drawer," said a participant.

5.6 Discussion

Our study along with available literature showed a definite need for a medical photography guide that can support doctors to master their technical skills and respect their ethical obligations. The main technical challenges that face a doctor photographer are mostly consistent with those found in the literature. However, our study has greater emphasis on technical aspects of photography such as the optical lens, light source and exposure. Interviewees discussed up-to-date techniques and instructions that help physicians improve their abilities.

Study participants acknowledged the importance of discussing the ethical challenges that could face a clinician while using a camera. Their photography experiences in the Canadian context have helped them appreciate the importance of these issues. While participants considered written assent as a predominant ethical challenge in Canada, there is little written in the medical literature about consenting minors and adult patients before capturing a photograph in a clinical setting [6, 21, 22]. Literature that does address ethical challenges in up-to-date practice mostly deals with using personal devices such as smartphones, editing photographs, documenting verbal consents, and transferring files between different parties including patients themselves [23-27]. While these are also very important matters, our study reviewed endorsements to address the most critical issues. The latter includes consent, confidentiality, and copyright.

Indeed, study participants proposed structural recommendations that could be applied to reach a successful achievement in camerawork operated by a doctor photographer. In particular, participants expressed the need to create a guide and incorporate teaching about photography into medical school and post-graduate curricula. They also stated that proper training is a crucial key to reach professionalism. Moreover, most of them expressed their willingness to help

physicians in dealing with medical photography challenges, and shared their experiences of tackling such issues.

Results of this study were summarized to craft a best-practice guide for physicians - *ABC Camerawork Guide for Dr. Photographer* [Table 2]. This guide consists of two major sections, which are (1) techniques; (2) ethics.

Technical C-CELL		
Camera	• Recommended minimum-sized sensor sufficient to photograph a patient is 24 mm x 15 mm. • Explore your camera buttons and functions. • Adjust time and date. • Format the memory card using camera settings.	
Composition	• Camera should be at least 90 centimeters away from the patient. • Background to be used is white, grey, green, or blue. • Patient should be at least 2 feet away from the background to prevent shadows. • If room dimensions do not allow enough space behind the patient, camera light must be reflected off the ceiling and wall corner. • Jewelry, makeup, and eyeglasses must be removed before shooting. • Oblique view when patient's body is turned 45 degrees. • Lateral view when patient's body is turned 90 degrees.	
	• Face	➢ Framed between the upper limit of the head and supra sternal notch. ➢ Frontal, oblique (right and left), lateral (right and left), inferior, and superior.
	• Nose	➢ Framed between the upper limit of the head and supra sternal notch. ➢ Frontal, oblique (right and left), lateral (right and left), inferior, and superior. ➢ Macro images to show all pathological lesions.
	• Ears	➢ Framed between the upper limit of the head and the lower limit of the mandibular body. ➢ Frontal, oblique (right and left), lateral (right and left), and posterior. ➢ Macro images to show all pathological lesions.
	• Eyelids	➢ Framed between the forehead and the cheek. ➢ Frontal, oblique (right and left), and lateral (right and left). ➢ Close-up photographs are necessary to evaluate eyelids lines, lesions and mobility.
	• Eyes	➢ Framed between the hairline and the nasal tip.

		➢ Frontal, oblique (right and left), and lateral (right and left). ➢ Frontal sequenced shoots are captured while the patient is looking up, up left, left, down left, down, down right, right, and up right. ➢ Macro snaps are necessary to evaluate conjunctival and corneal pathology.
	• Breasts	➢ Framed between the clavicular line and the umbilical level. ➢ Frontal, oblique (right and left), and lateral (right and left). ➢ All views are captured in three sequences, hands above the head, hands behind the back, and hands over the flanks.
	• Hands	➢ Framed between the finger tips and the wrist. ➢ Dorsal with the wrist, volar with the wrist, dorsal with fingers adducted, volar with fingers adducted, dorsal with fingers abducted, volar with fingers abducted, dorsal with clenched fist, volar with clenched fist, dorsal with third, fourth and little fingers extended, volar with third, forth, and little fingers extended.
	• Fingers	➢ Framed between the finger tips and the wrist including metacarpophalangeal (MCP) joints. ➢ Dorsal, and volar.
	• Forearms & elbows	➢ Framed between the MCP joints and mid-humerus level. ➢ Dorsal and volar views of forearm and elbows while the arm is extended, side view of forearm and elbow while wrist is flexed, and side view of forearm and elbow while wrist is extended.
	• Abdomen	➢ Framed between the nipple line and mid-thigh level. ➢ Frontal, oblique (right and left), lateral (right and left). ➢ All views are captured in different views; arms raised over the head, trunk bent more than 45 degrees, and during Valsalva maneuver.
	• Posterior trunk	➢ Framed between the posterior hairline and mid-thigh level. ➢ Back view.
	• Flanks & thighs	➢ Framed between the umbilical level and the knee level. ➢ Frontal, anterior oblique (right and left), lateral (right and left), posterior oblique (right and left), and posterior.

		➢ All views are captured with abducted and adducted thighs. ➢ Posterior view is captured with and without contracted gluteal muscles.
	• Legs and feet	➢ Framed between the knee level and the toes. ➢ Frontal, lateral (right and left), and posterior. ➢ Feet must be captured separately including both plantar and dorsal surfaces.
Exposure	• Shutter speed: 1 / double focal length. • ISO: 100 to 400. • Aperture: f-stop 8 to 11.	
Lens	• Tele-zoom lens: 24-70 mm. Full body: 50 mm Head and neck: 70 mm Shoulders: 70 mm Extended arms: 50 mm Hands and fingers: 70 mm Trunk: 50 mm Breasts: 70 mm Thighs and legs: 50 mm Feet: 70 mm • Macro lens: 105 mm. Objects less than 8 cm Cavities	
Light	• Camera mounted speedlight flash with a diffuser or an umbrella. • Lens mounted ring flash.	
Ethical CCC		
Consent	• Informed written. • Documented in the medical chart. • State all usages of the photo in details.	

Confidentiality	• Use ID codes and dates instead of patients' names. • Use facility owned equipment. • Store files on facility secured database. • Backup encrypted files on facility owned hard drives or a backup database. • Cropping face. • Blocking eyes, eyebrows, nasal bridge and lower half of forehead.
Copyright	• Photographs are owned by the healthcare facility. • Reproducing, publishing, editing, and selling photographs need patient's permission.

Table 2: ABC Camerawork Guide for Dr. Photographer

5.7 Study limitations

This study is exploratory qualitative. Despite the small number of interviewees, we obtained a diverse sample with a wide range of views and were able to reach data saturation. Although generalizability was not our target, we were capable of exploring the experiences and perceptions of our participants, which shed some light on this previously understudied area of inquiry.

5.8 Implications for practice

Better addressing photography skills used in clinical practice would require educating medical students, residents and practicing physicians. A detailed guide should be integrated in medical school and residency programs curricula.

5.9 Conclusion

This study yields a properly shaped best-practice guide to assist physicians in using cameras in clinical practice. The guide highlights the most important technical and ethical elements needed to craft a precise photograph.

Appendix 1:

Research Letter of Invitation

Title: Developing A Guide for Principles of Modern Medical Photography Skills

Persons responsible:

MUHC: Sam J Daniel, MD

MUHC: Farid F Ibrahim, MD

Today, we are inviting you to take part in a medical photography educational research study. We believe that you are a good candidate to join our study. It is important that you understand this information.

Introduction:

Current evidence clearly demonstrates the importance of medical photography in up-to-date medical practice and modern medical education. However, there is a lack of knowledge about technical aspects, data management, ethical issues and legal aspects of medical photography using Digital Single Lens Reflex (DSLR) cameras. The aim of this study is to explore the missing knowledge and to develop a tool (guideline) that can help physicians and residents master their photography skills.

Objectives:

The main objective of this study is to develop a guideline that assists clinicians, surgeons and residents in using cameras in clinical and surgical settings. Establishing a guideline will improve the physicians' awareness of the importance of medical photography and it will also improve their photography skills.

What is your role in the study?

Your opinion is very important. Therefore, you will go for an approximately 60-minute interview about technical and ethical elements needed to craft a medical photography guideline.

Are there any risks from participating in the study?

There is no inconvenience other than the time it takes for the interview.

Are there any benefits from participating in the study?

You will have free access to the guide once published.

How is your privacy ensured?

All information obtained during the study will be kept confidential as required or permitted by law. Your identity will be protected by replacing your name with a research number. Data will be de-identified and coded. The code will be kept by the principle investigator in a password protected digital file behind the McGill University Health Centre (MUHC) firewall.

Only the research team will have access to documents regarding any part of the study, including but not limited to: any communication between the various parties, i.e. PI/Subjects, Researchers/PI, and Researchers/Subjects, consent forms, and interview transcripts.
Data will be stored under lock-and-key for a period of seven years following the termination of the project. All recordings from interviews will be transcribed verbatim for data analysis. Details concerning individuals, their facilities or other identifying information will be removed from the transcripts, after which original recordings will be destroyed. Each participant will be given a code identifier to allow tracking of individuals.

For more information, ***you can contact the researchers in charge;***

Dr. Sam J Daniel at *sam.daniel@mcgill.ca*

Dr. Farid F Ibrahim at *farid.ibrahim@mail.mcgill.ca*

Thank you.

Appendix 2:

Interview Script

[Prior to starting, complete the consent form for each participant]

Thank you for having signed the consent form and agreeing to participate in this interview for our study - ***Developing A Guide for Principles of Modern Medical Photography Skills.***

1. Please describe briefly what kind of photography worker are you, how long have you been working and primarily in what setting, when did you start capturing medical photos in your practice?

The following questions refer to your technical expertise in taking medical photos in a healthcare facility either at a hospital, clinic, office, or a medical education facility

2. How frequent do you seek further professional help to take the photograph?

3. What kind of equipment you use to take photos? Are they personal or facility equipment?

4. In your experience, what are the most common technical challenges faced by clinicians in taking medical photographs?

5. How do you adjust your camera to take a proper photo?

Please mention the lighting either external on camera flash or ring flash,
Exposure including the ISO and the shutter speed you usually use,
Lens you use including the focal length and the depth of field,
Patient position and their distance from the camera and from the background,
Auto or manual focus,
Format of files you use when you use the camera.

6. How do you frame your photos – in another word, describe the anatomical frame when you

take a medical photograph!

7. How many photos do you usually take, and why?

The following questions refer to your ethical knowledge about taking medical photos and using them

8. In your experience, what are the most common ethical challenges faced by clinicians in taking medical photographs?

9. Do you usually obtain consent from your subjects? Verbal or written? What do you do in case of minors?

10. How do you usually handle the photos after capturing them using a camera;
Storage (on hospital or facility hard drive, personal hard drive, or on the internet),
Transmission of the files (for example emailing or texting to other parties),
Editing (why and what software you use),
Printing (do you get them printed and how you store the print outs?)

11. Could you please elaborate on photograph copyright issues?

12. How do you insure patients' privacy and confidentiality?

13. How do you use the photos after being taken?

The following questions refer to your opinion about having photography guideline and training available to healthcare providers

14. Do you think that healthcare providers including medical educators need to receive training in medical photography? Why?

15. What would be your key messages on how healthcare providers can better take photographs of their patients with proficiency?

The interview is now over. Thank you for your time.

Do you have any additional comments that you would like to add?

References

1. Strub B, Meuil-Simmen C, Bessler S. Photodocumentation in rhinoplasty surgery. Eur J Plast Surg. 2013; 36:141-148.

2. Infotrend. Digital cameras will nearly replace film camera. [www.infotrends.com/main/public/content/press/2003/06.25.2003.html].

3. Businessweek. Refocusing on digital cameras. [www.businessweek.com/lifestyle/content/jun2008/bw2008063_446683.htm].

4. Galdino GM, Vogel JE, Vander Kolk CA: Standardizing digital photography: it's not all in the eye of the beholder. Plast Reconstr Surg. 2001; 108:1334–1344.

5. Zolite T. Professional development in medico-legal photography: understanding the importance of a clinical photographers role. J Vis Commun Med. 2013; 36:82-85.

6. Bhattacharya S. Clinical photography and our responsibilities. Indian J Plast Surg. 2014; 47:277-280.

7. Sheridan P. Practical aspects of clinical photography: part 1- principles, equipment and technique. ANZ J Surg. 2013, 83:188-191.

8. Sen Z, Kaya B, Serel S, Saglam H, Can Z. Photographic standardization in esthetic surgery. Ankara Univ Tip Fak. 2005, 85:5-10.

9. Yavuzer R, Smirnes S, Jackson IT. Guidelines for standard photography in plastic surgery. Ann Plast Surg. 2001, 46:293-300.

10. Hill K. Consent, confidentiality and record keeping for the recording and usage of medical images. J Visual Commun Med. 2006, 29:76-79.

11. Ong C T, Yap J, Wai Y, Ng QX. A review of oculoplastic photography: a guide for clinician photographers. Cureus. 2016, 8:e733.

12. Harting MT, DeWees JM, Vela KM, Khirallah RT. edical photography: current technology, evolving issues and legal perspectives. Int J Clin Pract. 2015 Apr;69 (4):401-409.

13. Peter S. Practical aspects of clinical photography: part 1 – principles, equipment and technique. Anz J Surg. 2013; 83:188-191.

14. Kontis TC. Photography in facial plastic surgery. In: Papel ID, editor. Facial plastic and reconstructive surgery. 3rd edition. New York: Thieme; 2009. P. 143-152.

15. Sandelowski M. Whatever happened to qualitative description? Res Nurs Health. 2000; 23(4):334-340.

16. Neergaard M, Olesen F, Andersen R, Sondergaard J. Qualitative description - the poor cousin of health research? BMC Med Res Methodol. 2009; 16; 9:52.

17. Marshall MN. Sampling for qualitative research. Fam Pract. 1996;13(6):522-5.

18. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. Nurse education today. 2004;24(2):105-12.

19. Crabtree BF, Miller WF. A template approach to text analysis: developing and using codebooks. 1992.

20. Milne J, Oberle K. Enhancing rigor in qualitative description. Journal of Wound, Ostomy and Continence Nursing 2005; 32:413-420.

21. Kunde L, McMeniman E, Parker M. Clinical photography in dermatology: Ethical and medico-legal considerations in the age of digital and smartphone technology. Aust J Derma. 2013; 54:192-197.

22. Pace N, Hendry R. Consent: ethical considerations. Anaesth. Intensive Care Med. 2006; 7:107-110.

23. Chan N, Charette J, Dumestre DO, Fraulin FO. Should ‘smart phones’ be used for patient photography? Plast Surg. 2016; 24:32-34.

24. Payne K F, Tahim A, Goodson A Mc, Delaney. A review of current clinical photography guidelines in relation to smartphone publishing of medical images. J Visual Communication in Medicine. 2013; 35:188-192.

25. Lawrence T, Wendy H, Ron B. Patient-initiated camera phone images in general practice. Br J Gen Pract. 2014; e:290-294.

26. Cagatay B, Hakan E. Guidelines for standard photography in gross and clinical anatomy. Anat Sci Educ. 2011; 4:348-356.

27. Devakumar D, Brotherton H, Halbert J, Clarke A, Prost A, Hall J. Taking ethical photos of children for medical and research purposes in low-resource settings: an exploratory qualitative study. BMC Med Eth. 2013; 14:27.

CHAPTER SIX: Quantitative Study

Teaching Principles of Medical Photography to Physicians: Pre and Post - Evaluation Pilot Study and a Survey

Farid F Ibrahim [a, b], MD; Gillian Bartlett [b], PhD; Sam J Daniel [a], MD

[a] Department of Otolaryngology-Head and Neck Surgery, The Montreal Children's Hospital, McGill University, Montreal, QC, Canada

[b] Department of Family Medicine, McGill University, Montreal, QC, Canada

Keywords: clinical, photography, guide, techniques, ethics, workshop

Running Head: Teaching Principles of Medical Photography

Contribution of authors:

Farid F Ibrahim contributed to the design of the study including both the workshop and the survey, meeting with photography instructors, teaching during the workshop, data collection, analysis and interpretation, and drafting the manuscript.

Gillian Bartlett contributed to the design of the study, conceptualization of the research question, and critical revision of the manuscript draft.

Sam J Daniel contributed to the design of the study, conceptualization of the research question and objectives, supervising and facilitating the workshop as the scientific committee president, and critical revision of the manuscript draft.

Authors in Order:

Farid F Ibrahim
Department of Family Medicine – Medical Education
Department of Otolaryngology – Head and Neck Surgery
McGill University

The Montreal Children's Hospital, McGill University
1001 Boul Decarie
Montreal, QC H4A 3J1
farid.ibrahim@mail.mcgill.ca

Gillian Bartlett
Department of Family Medicine
McGill University

5858, chemin de la Côte-des-Neiges, Suite 300
Montréal, QC H3S 1Z1

gillian.bartlett@mcgill.ca

Sam J Daniel
Department of Otolaryngology – Head and Neck Surgery
McGill University

The Montreal Children's Hospital, McGill University
1001 Boul Decarie
Montreal, QC H4A 3J1
sam.daniel@mcgill.ca

Linking statement

Results of the qualitative study (chapter 5) filled the knowledge gap in the current literature and successfully crafted a best-practice medical photography guide - ABC camerawork guide for Dr. photographer. The latter acted as the main foundation of a hands-on workshop.

The quantitative experimental study, which follows, used the workshop to teach principles of medical photography to a wide range of healthcare providers. The study was designed to evaluate participants' skills before and after the workshop so as to test and validate the guide.

6.1 Abstract

Introduction:

Current technology made digital photography broadly accessible. Photographers along with clinicians and surgeons have been trying to establish gold standards when obtaining medical photos. Basic understanding of photographic principles, continuous practice of different techniques, and usage of accurately selected equipment contribute significantly to the standardization of photographs. Health professionals do not have access to a validated and conclusive guide.

Objective:

To assess physicians' ability of crafting quality photographs before and after medical photography hands-on workshop, in order to validate a best-practice guide.

Study design:

A pilot study with pre-post-test quasi-experimental design, and a survey.

Methodology:

Twenty practicing physicians were enrolled voluntarily to participate in a hands-on training session. The latter presented a medical photography best-practice guide – ABC Camerawork Guide for Dr. Photographer. Structured assignment to evaluate understanding of ethical and technical principles of medical photography was given to all participants before and after the workshop. Assignments were evaluated and the results were compared. SPSS software was used for data analysis with p-value <0.05 as a significant level. Additionally, a survey was sent to attendees, which collected their feedback and recommendations regarding the training session.

Results:

Nine participants out of the twenty participants were able to reach a score of 100% after attending the workshop. Paired two tailed t-test for pre and post assignments revealed a statistically significant difference between participants' skills before and after the workshop, with a p-value of < .0001. Nine attendees (45%) responded to the survey after the workshop and showed their satisfaction with the training session and the instructors as well.

Conclusion:

Producing a high-quality medical photograph improved significantly and immediately in physicians using a medical photography guide acquired in a hands-on workshop.

6.2 Introduction

Camera work is of great importance in the up-to-date medical practice. During the last few years, illustrative clinical records have become an important aspect of the patients' medical charts [1]. Therefore, it became a routine practice for healthcare providers to use a camera in all clinical settings. Unquestionably, clinical images are of a great aid in medical consultation and documentation, medical education and training, patient and family education, and medical publications and presentations [2]. Moreover, a high-quality image is critical in the health sector because it may be used for case management and legal justification as well [3]. Consequently, medical photographs must be accurate, consistent, reliable, reproducible, and ethical [4].

Modest photographs; due to errors such as inconstant setups, inadequate exposure, wrong framing and positioning, unsteady focal length, and inappropriate consenting, can misrepresent the patient's case and distort the medical reality [5]. Furthermore, poor photography can lead to unpleasant legal consequences [4, 5]. Therefore, photographic standardization using quality equipment in an ethical manner is the best approach to avoid these errors and produce a high-quality image [3].

Although healthcare providers are not expert photographers, modern cameras have simplified the process of capturing and utilizing images [1]. However, it is still challenging to capture high-quality snapshots with proficiency and utilize them in an ethical fashion without compromising patient privacy. Therefore, a validated standardization guide is needed to help capture ethically and technically proficient photographs.

Published literature has discussed a few protocols and personal opinions regarding different techniques used to photograph patients [6-13]. However, these lack consensus, have not been widely adopted, and are not validated. The aim of this study is to test and validate a medical

photography guide “ABC Camerawork Guide for Dr. Photographer” that was developed initially by the authors.

6.3 Methodology

6.3.1 Method

A medical photography best-practice guide crafted initially [Table 1] was tested by comparing results obtained from an assignment given to twenty medical photography users in Quebec, Canada before and after exposure to a structured three-hour hands-on-workshop. The latter presented the best-practice guide. Prior to the workshop itself, participants went through a practical task where they were asked to capture a photograph of an ear, and another one of a face. Assignments evaluated participants before and after the workshop on ten different standards as stated in the evaluation form [Appendix 1]. They included (1) handling the camera and the lens; (2) adjusting the ISO; (3) mastering lighting exposure and flash use; (4) adjusting the shutter speed according to the situation; (5) understanding focus; (6) selecting the right focal length according to the target being photographed; (7) mastering patient positioning; (8) using a proper background; (9) respecting the patient privacy and confidentiality; (10) explaining the purpose of the photograph and how it will be used. For each standard item, the instructor rated each participant on a five-point Likert scale, from very poor (1) to excellent (5). Furthermore, the same assignment was repeated after the workshop for results to be compared.

Moreover, participants were asked to evaluate the guide and the workshop session through an anonymous survey. Questionnaires were emailed to all attendees seeking their opinion, appraisal and recommendations after joining the workshop. Forms were structured into several themes, such as the learning objectives attendees gained of the workshop, feedback about

instructors, feedback about the session activity, and recommendations for future workshops [Appendix 2].

6.3.2 Study Design and data analysis

A quasi-experimental study design was applied in this study without a control group. The small sample size made the one group pre – post quasi design the perfect fit. For each distinct standard of the assignment form, scores were collected and frequencies were calculated and compared before and after the workshop. Furthermore, mean score of pre-test and post-test assignments were estimated and then compared. The scores of the assignments (before and after the workshop) were collected and a paired two-tailed t-test was used to evaluate the standard deviation of the mean difference, and the confidence interval as well as the p-value. All analyses were performed using SPSS® software. Results were considered statistically significant for a p-value less than 0.05. Additionally, participants' understanding, opinion and recommendations regarding the workshop activity were recorded through a survey.

6.3.3 Workshop

A three-hour faculty developed workshop on medical photography took place as a session of the 10th Annual Interdisciplinary day (Journée de formation interdisciplinaire (JFI)) of the Federation of Medical Specialists of Quebec. The workshop included detailed presentation, demonstration and hands-on medical photography training session. The presentation was conducted in one assembly, and attendees were divided afterwards into four groups for demonstration and hands-on sessions that were offered concurrently. The one-hour presentation included ethical and technical elements of medical photography. The two-hour session allowed attendees to ask questions, apply the best-practice guide as discussed in table one, and try different photography techniques [Table 1].

All physicians had individual access to a complete set of photography equipment throughout the whole setting. Each participant was equipped with a DSLR camera, a 24-70 mm tele-zoom lens, a 105 mm macro lens, an on-camera speedlight flash, a ring flash and a light diffuser as well. Groups were facilitated by skillful instructors who had experience in photography tutoring [Fig 1]. To ensure consistency in teaching among groups, instructors taught the same content of the ABC camerawork guide via demonstration and hands-on practice [Table 1].

Table 1:

Technical C-CELL		
Camera	• Recommended minimum-sized sensor sufficient to photograph a patient is 24 mm x 15 mm. • Explore your camera buttons and functions. • Adjust time and date. • Format the memory card using camera settings.	
Composition	• Camera should be at least 90 centimeters away from the patient. • Background to be used is either white, grey, green, or blue. • Patient should be at least 2 feet away from the background to prevent shadows. • If room dimensions do not allow enough space behind the patient, camera light must be reflected off the ceiling and wall corner. • Jewelry, makeup, and eyeglasses must be removed before shooting. • Oblique view when patient's body is turned 45 degrees. • Lateral view when patient's body is turned 90 degrees.	
	• Face	➢ Framed between the upper limit of the head and supra sternal notch. ➢ Frontal, oblique (right and left), lateral (right and left), inferior, and superior.
	• Nose	➢ Framed between the upper limit of the head and supra sternal notch. ➢ Frontal, oblique (right and left), lateral (right and left), inferior, and superior. ➢ Macro images to show all pathological lesions.
	• Ears	➢ Framed between the upper limit of the head and the lower limit of the mandibular body. ➢ Frontal, oblique (right and left), lateral (right and left), and posterior. ➢ Macro images to show all pathological lesions.
	• Eyelids	➢ Framed between the forehead and the cheek. ➢ Frontal, oblique (right and left), and lateral (right and left). ➢ Close-up photographs are necessary to evaluate eyelids lines, lesions and mobility.
	• Eyes	➢ Framed between the hairline and the nasal tip.

		➢ Frontal, oblique (right and left), and lateral (right and left). ➢ Frontal sequenced shoots are captured while the patient is looking up, up left, left, down left, down, down right, right, and up right. ➢ Macro snaps are necessary to evaluate conjunctival and corneal pathology.
	• Breasts	➢ Framed between the clavicular line and the umbilical level. ➢ Frontal, oblique (right and left), and lateral (right and left). ➢ All views are captured in three sequences, hands above the head, hands behind the back, and hands over the flanks.
	• Hands	➢ Framed between the finger tips and the wrist. ➢ Dorsal with the wrist, volar with the wrist, dorsal with fingers adducted, volar with fingers adducted, dorsal with fingers abducted, volar with fingers abducted, dorsal with clenched fist, volar with clenched fist, dorsal with third, fourth and little fingers extended, volar with third, forth, and little fingers extended.
	• Fingers	➢ Framed between the finger tips and the wrist including metacarpophalangeal (MCP) joints. ➢ Dorsal, and volar.
	• Forearms & elbows	➢ Framed between the MCP joints and mid-humerus level. ➢ Dorsal and volar views of forearm and elbows while the arm is extended, side view of forearm and elbow while wrist is flexed, and side view of forearm and elbow while wrist is extended.
	• Abdomen	➢ Framed between the nipple line and mid-thigh level. ➢ Frontal, oblique (right and left), lateral (right and left). ➢ All views are captured in different views; arms raised over the head, trunk bent more than 45 degrees, and during Valsalva maneuver.
	• Posterior trunk	➢ Framed between the posterior hairline and mid-thigh level. ➢ Back view.
	• Flanks & thighs	➢ Framed between the umbilical level and the knee level. ➢ Frontal, anterior oblique (right and left), lateral (right and left), posterior oblique (right and left), and posterior.

		➢ All views are captured with abducted and adducted thighs. ➢ Posterior view is captured with and without contracted gluteal muscles.
	• Legs and feet	➢ Framed between the knee level and the toes. ➢ Frontal, lateral (right and left), and posterior. ➢ Feet must be captured separately including both plantar and dorsal surfaces.
Exposure	• Shutter speed: 1 / double focal length. • ISO: 100 to 400. • Aperture: f-stop 8 to 11.	
Lens	• Tele-zoom lens: 24-70 mm. Full body: 50 mm Head and neck: 70 mm Shoulders: 70 mm Extended arms: 50 mm Hands and fingers: 70 mm Trunk: 50 mm Breasts: 70 mm Thighs and legs: 50 mm Feet: 70 mm • Macro lens: 105 mm. Objects less than 8 cm Cavities	
Light	• Camera mounted speedlight flash with a diffuser or an umbrella. • Lens mounted ring flash.	
Ethical CCC		
Consent	• Informed written. • Documented in the medical chart. • State all usages of the photo in details.	

Confidentiality	• Use ID codes and dates instead of patients' names. • Use facility owned equipment. • Store files on facility secured database. • Backup encrypted files on facility owned hard drives or a backup database. • Cropping face. • Blocking eyes, eyebrows, nasal bridge and lower half of forehead.
Copyright	• Photographs are owned by the healthcare facility. • Reproducing, publishing, editing, and selling photographs need patient's permission.

Table 1: ABC Camerawork Guide for Dr. Photographer

Figure 1:

Figure 1: An instructor assists and leads a group of participants

(Copyright: FMSQ & Empay Photographe)

6.4 Results

6.4.1 Pre and post quasi-experimental study

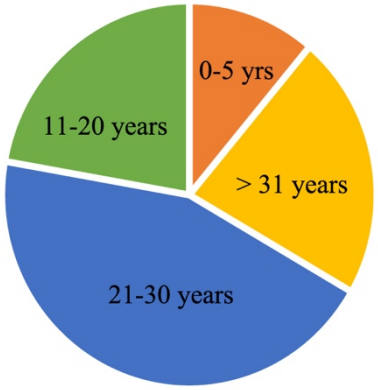
6.4.1.1 A total of twenty physicians participated in the workshop. Their medical experience frequency showed the highest rate of 44.4% in the group of 21 to 30 years of experience as compared to frequency of 22.2 % in the groups of 11 to 20 years and above 30 years of medical practice [Table 2, Fig 2].

Table 2:

Years of experience	Frequency
Resident	0%
0 – 5 years	11.1%
6 – 10 years	0%
11 – 20 years	22.2%
21 – 30 years	44.4%
More than 31 years	22.2%

Table 2: Frequency of medical experience years among participants

Figure 2:



6.4.1.2 Scores of different assignment items were collected for each participant according to the five-point Likert scale. Grades were calculated, and frequencies of total results of each skill standard were compared before and after the workshop session [Fig 3]. Pre-test skill frequency presented high rates of 50%, 55%, and 56% in mastering patients' positioning, respecting patient privacy and confidentiality, and explaining the purpose of the photograph and how it will be used respectively. On the other hand, all frequencies of post-test skills ranged between 90% and 94% [Fig 3]. Frequency of score difference between prior and after the workshop regarding each distinct skill standard was calculated [Fig 4]. It showed the highest rates of 60% and 62% skill improvement in mastering the lighting exposure and flash use, as well as adjusting the shutter speed respectively.

Figure 3:

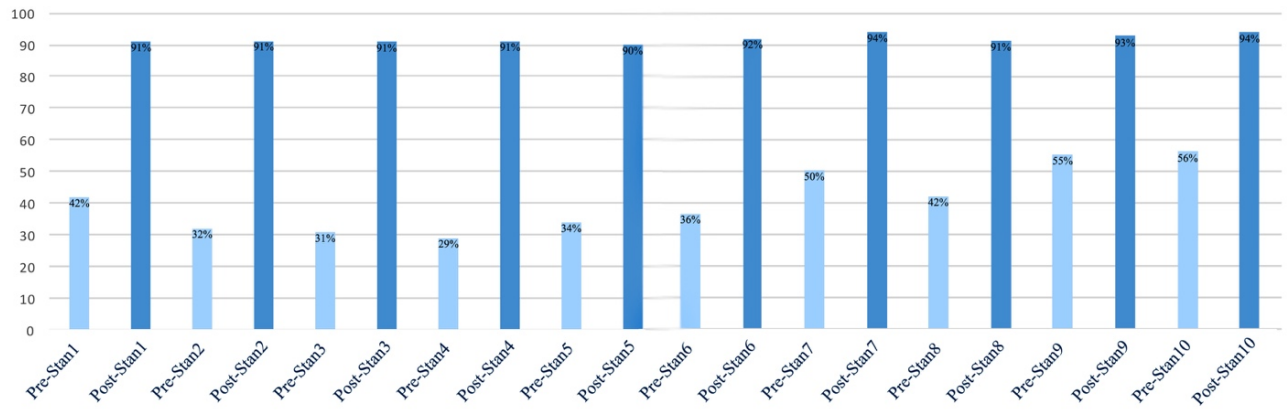


Figure 3: Pre and post total score frequency for each different skill

Figure 4:

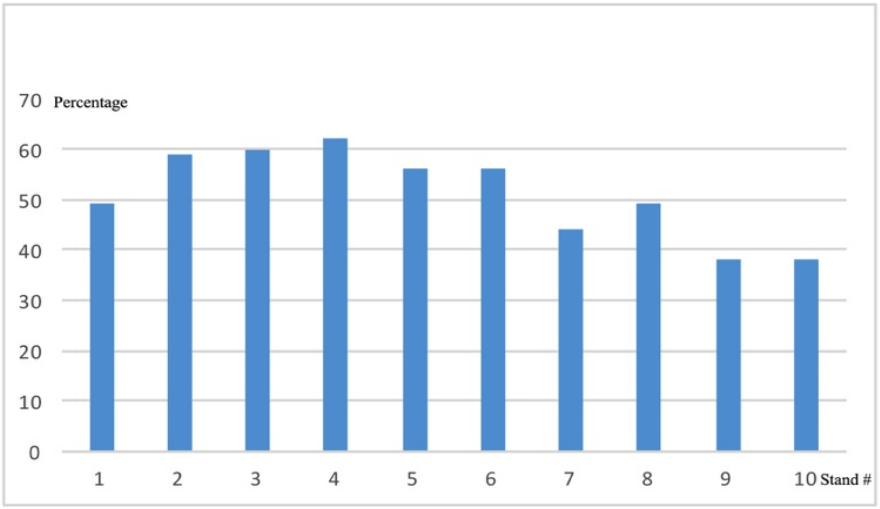


Figure 4: Frequency of score growth for each distinct skill

6.4.1.3 Assignments evaluations were graded out of 50 points, with a pre-test mean score of 20.3 versus post-test mean score of 45.9. Also, final grades were compared for each participant before and after the workshop. Nine participants out of twenty were able to reach a mark of 100% after attending the workshop, whereas ten participants reached scores ranged from 80% to 98%. Mean value of score differences were calculated and showed that the guideline-based workshop had increased the overall participants' photography ability with 25.5 points with a standard deviation of 7.1. Furthermore, we are 95% confident that the mean improvement in physicians' medical photography skills is 22.2 to 28.8 points. Paired two-tailed t-test for pre and post assignments revealed a statistically significant difference between participants' skills before and after the workshop, with a p-value of $< .0001$.

6.4.2 A survey

An eleven-question questionnaire was sent to all participants [Appendix 2]. Nine out of the twenty attendees answered the survey questions and sent us back their responses. The following section presents the survey questions and attendees answers.

6.4.2.1 What were your learning objectives for this activity?

All nine responders explained their learning objectives in regard to the first two objectives of the workshop. However, only five responders mentioned their third activity objective [Table 3].

Table 3:

#	**Objective 1 : Apply ethical guidelines for medical-photo documentation**	**100%**
1	Know the regulations surrounding medical photography	
2	See the state of current knowledge	
3	Know about the photo copyright	
4	Know the medico-legal aspects surrounding photos taken from patients	
5	Know the medico-legal component of the medical photos	
6	Know the rules regarding medical photography	
7	Understand the implications of archiving medical photos	
8	Know how to use medical photos in a correct manner	
9	Apply what I learnt during the workshop to my clinical practice	
#	**Objective 2: Make quality medical photographs using the right tools**	**100%**
1	Know how to take control while capturing patients' photographs	
2	How to improve image quality	
3	What to do with the photos	
4	Know how to manage photos that are captured from patients	
5	How to properly archive medical photos	
6	Know the medico legal aspects of sending photos by emails	
7	Learn the basics of a good-quality medical photo	
8	Understand the implications of transmitting medical photos	
9	Know the rules governing taking photos in a medical context	
#	**Objective 3: Mastering necessary photography skills including DSLR**	**55.5%**

	cameras, lens adjustment, focal length, exposure, lighting, and patient positioning	
1	Knowledge of techniques to craft a quality photograph	
2	Have answers to practical questions	
3	Dealing with images on the camera after capturing them	
4	Medical photos and social media	
5	Optimize the quality of photograph	

6.4.2.2 Did this training meet your learning objectives?

All nine responders agreed that the training met their learning expectations.

6.4.2.3 What are the key messages that you have gained during this activity in regard to the workshop's key messages?

All nine responders explained the key points they gained in regard to the first two messages of the workshop. However, only six responders stated their third activity message [Table 4].

Table 4:

#	**Message 1: Medical-photo documentation ethics**	**100%**
1	To establish consent	
2	Criteria for rending ethical steps	
3	How to document medical photos	
4	Before taking pictures of patients, we must know how to manage the whole camerawork process	
5	Adjust the legal side of medical photos	
6	Using medical photos in teaching	
7	Any medical photo should be attached to the patient's chart	
8	Archive the photos securely on hospital database	
9	Confidentiality and privacy concealing	
#	**Message 2: Quality medical photographs using the right tools**	**100%**
1	Obligation of doctors towards management of photos	
2	Conceal patient's identity	
3	Collect informed consent from patients	
4	Know how to protect patient's privacy	
5	Archive photos and consent properly	
6	Informed consent	
7	Insure patients' confidentiality	
8	Encrypt files and prevent patients from being identifiable	
9	Document reasons for takings photographs in a patient's chart	
#	**Message 3: Technical photography skills**	**66.6%**
1	Technical knowledge	
2	Specific lighting conditions	
3	Pictures can be an element to document patient's disease	
4	Avoid shadows in medical photographs	
5	Using diffusers to soften the light	
6	Use a ring flash for cavities and macro photos	

6.4.2.4 How would you evaluate the instructors in regard to their skills?

All nine responders rated instructors' skills in regard to the first eight skills [Table 5]. However, only eight responders rated instructors' last skill [Table 5]. More than 99% of

responders agreed that instructors described and explained all objectives of the workshop, mastered the medical photography topic, facilitated the interaction between participants during the workshop, presented a good quality educational material which is relevant to the medical practice, and have good teaching skills with no bias [Table 5]. However, one responder did not agree that conflict of interest was well declared by instructors [Table 5].

Table 5:

Skill	Totally disagree	Disagree	Agree	Totally agree	Total
1. Described and respected the objectives of their presentation	0.0% 0	0.0% 0	33.3% 3	66.6% 6	9
2. Facilitated the interaction with the participants	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9
3. Mastered their subject	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9
4. Respected the time allocated for the workshop	0.0% 0	0.0% 0	44.4% 4	55.5% 5	9
5. Presented the workshop as a good quality educational material	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9
6. Presented material relevant to my practice	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9
7. Had good instructor skills	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9
8. Their workshop was not biased	0.0% 0	0.0% 0	11.1% 1	88.8% 8	9
9. Declared their conflict of interest	0.00% 0	12.5% 1	12.5% 1	66.6% 6	8

6.4.2.5 How would you rate the guideline influence on your practice?

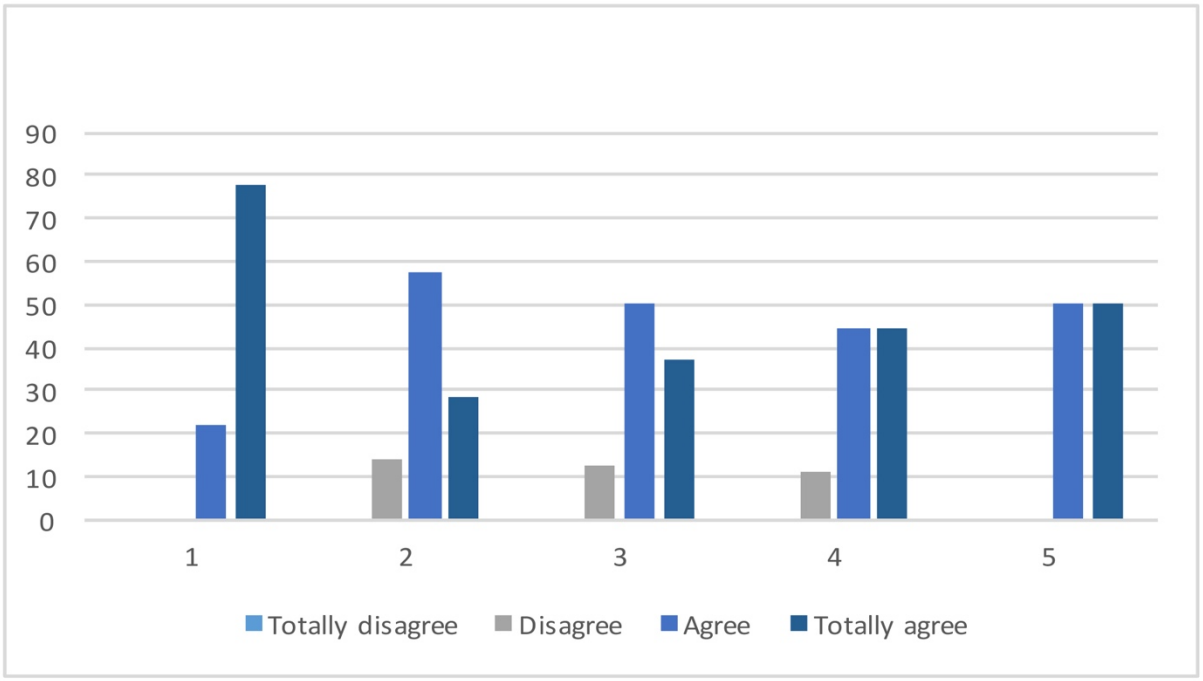
All nine responders rated the workshop relevancy on their medical practice and its influence on their camera use [Table 6]. Eight out of the nine responders rated the workshop encouragement on their photography skills and the presentation respect to the session's objectives [Table 6]. However, only seven responders rated their own photography techniques in

regard to the guideline session [Table 6]. More than 77% of responders totally agreed that the workshop presented a message relevant to their medical practice [Fig 6].

Table 6:

	Totally disagree	Disagree	Agree	Totally agree	Total
1. This workshop presented a message (s) relevant to my practice	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9
2. This training confirms the techniques I use in my practice	0.0% 0	14.2% 1	57.1% 4	28.5% 2	7
3. This workshop encourages me to modify certain aspects of my photography skills	0.0% 0	12.5% 1	50.0% 4	37.5% 3	8
4. This workshop encourages me to gather more information about photography and keep using my camera	0.0% 0	11.1% 1	44.4% 4	44.4% 4	9
5. The presentation respected the stated objectives	0.0% 0	0.0% 0	50.0% 4	50.0% 4	8

Figure 6:



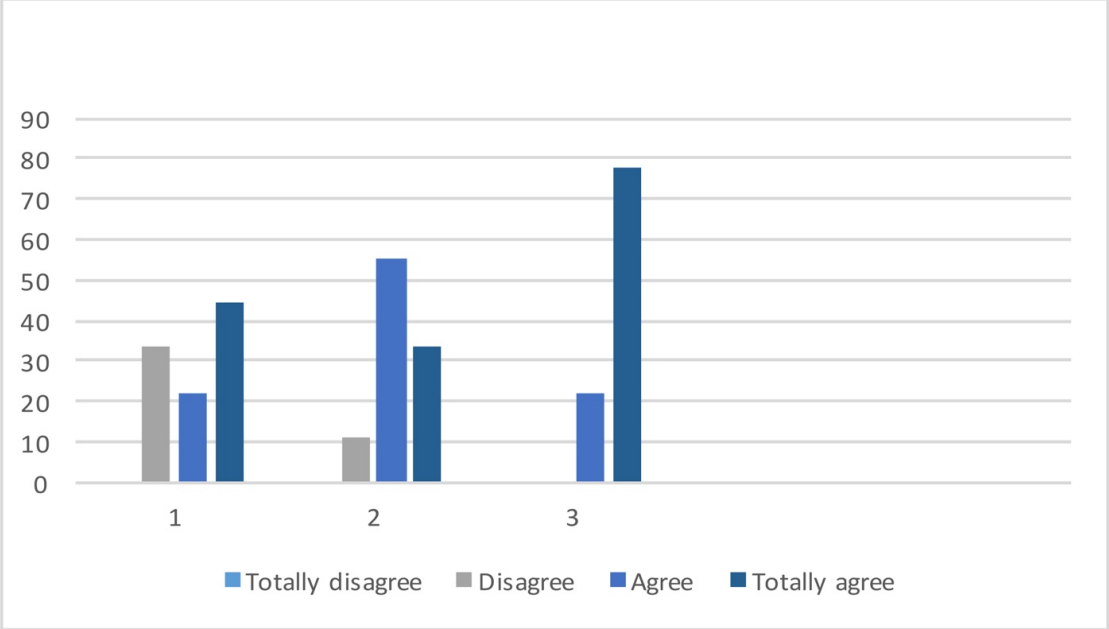
6.4.2.6 What is your opinion about the knowledge assessment session?

All nine responders rated the workshop case-presentation, hands-on, and interactive approaches in regard to the session learning objectives [Table 7]. More than 77% of responders totally agreed that the interactive approach helped consolidate their learning. More than 55% of responders agreed that the hands-on method was an appropriate way for the workshop. However, 33% of responders did not agree that the case-presentation approach was suitable for the session [Fig 7].

Table 7:

	Totally disagree	Disagree	Agree	Totally agree	Total
1. The case presentation approach allowed me to properly evaluate my skills	0.0% 0	33.3% 3	22.2% 2	44.4% 4	9
2. The educational approach used in the hands-on session was appropriate for the session	0.0% 0	11.1% 1	55.5% 5	33.3% 3	9
3. Interactive approach allowed me to consolidate my learning.	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9

Figure 7:



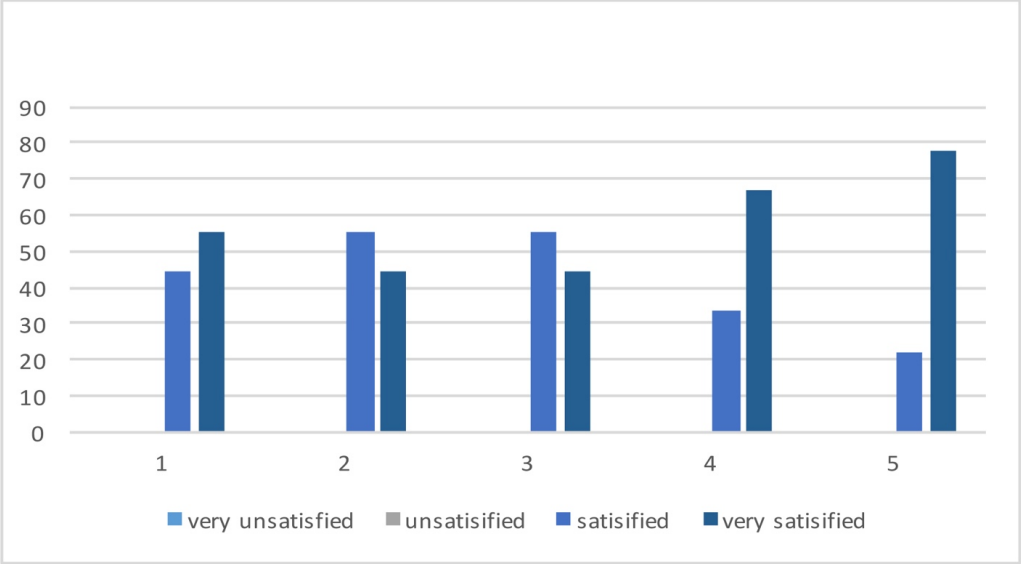
6.4.2.7 What is your satisfaction level with the workshop activity in general?

All nine responders rated their satisfaction level according to the table below [Table 8]. All responders were satisfied with the workshop location, training room layout, audiovisual quality and its respect to the ethical code of Conseil québécois de développement professionnel continu des médecins (CQDPCM) [Fig 8].

Table 8:

	Very unsatisfied	Unsatisfied	Satisfied	Very satisfied	Total
1. Choice and quality of the workshop location	0.0% 0	0.0% 0	44.4% 4	55.5% 5	9
2. Quality of meals provided during the break	0.0% 0	0.0% 0	55.5% 5	44.4% 4	9
3. Training room layout	0.0% 0	0.0% 0	55.5% 5	44.4% 4	9
4. Audiovisual quality	0.0% 0	0.0% 0	33.3% 3	66.6% 6	9
5. The organization of this activity respects to the ethical code of Conseil québécois de développement professionnel continu des médecins (CQDPCM)	0.0% 0	0.0% 0	22.2% 2	77.7% 7	9

Figure 8:



6.4.2.8 What are the strengths of the workshop session?

Seven of the nine responders shared their thoughts about the workshop strengths in regard to educational fundamentals [Table 9].

Table 9:

#	Response
1	Excellent presentation on the ethical part
2	Exchange with instructors
3	Practice with real devices
4	Instructors had very good control over the subject of medical photography
5	The interdisciplinary nature of the workshop and the group work
6	Workshop was very useful to teach us how to capture a good photo and also showed us the gap in the health system with regard to digital photographs and their transmission and storage
7	Exhibitions of the rules to be respected and the practical workshop for taking quality photograph

6.4.2.9 Do you have any specific comments for future workshops?

Only two attendees shared their comments in regard to future sessions. It was requested to allow more time for the workshop and to present different photography techniques that could be used during surgeries.

6.4.2.10 In your opinion, what are the areas that need improvement for this activity?

Five out of the nine responders gave different opinions to improve the workshop activity in the future. Their opinions included explaining camera manipulation and adjustment in an easier way, allowing more time to the workshop, and providing different solutions for photographs storage and data management when the institution does not have a computerized system for photographs but the practice still requires the use of photos.

6.4.2.11 What topics would you like to discuss in future sessions?

Only two responses were received. One responder showed their interest to learn how to photograph a patient during an emergency situation. The other responder showed the need to have this workshop as a continuous educational session .

6.5 Discussion

This study suggests that a simple intervention can improve physicians' ability to use a camera in a proficient manner and utilize the photos in an ethical way. Despite the small sample size, the study demonstrated significant improvement in both technical and ethical photography skills after attending a hands-on workshop and following the "ABC camerawork guide for Dr. photographer". Repeating this workshop session over a longer period of time could potentially yield even greater gains and was requested by most of the attendees.

The study confirms that the best-practice guide is conclusive regarding technical methods needed to capture high quality photographs in different clinical situations. It includes different techniques starting of selecting the proper equipment, to positioning the patient. However, it has very limited instructions regarding camera usage in operating rooms.

The accurate choice of camera-set plays a fundamental role in producing high quality photographs. Equipment for modern medical photography should consist of a digital single-lens reflex camera, a tele-zoom lens (24-70 mm), a macro lens (105 mm), an on-camera flash, a ring flash, and a clear reflector or a soft box. Considering ethical matters, the guide summarizes the most important issues that need to be addressed. It discusses specific instructions to protect patient's privacy, and image copyright as well.

Whilst there are no studies discussing a validated definite medical photography guide using a DSLR camera system, there have been several published protocols about utilizing photography in the medical practice [14-18]. Although these protocols were

based on personal opinions and showed promising results, none has assessed physicians' performance changes following these guidelines.

The "ABC camerawork guide for Dr. photographer" had improved overall physicians' skills to capture photographs. Eleven out of the twenty physicians had reached a score more than 95% on the second assignment after applying the guide. Nine of the twenty workshop participants shared their opinions through a post activity survey. They all disclosed that the guide and the activity had met their learning objectives and were relevant to their medical practice. However, only seven of the nine responders agreed that the guide encouraged them to modify their photography skills.

Although the study included limited number of participants, it confirmed the need and the success of the presented best-practice guide.

6.6 Study limitations

Quasi-experimental design lacks randomization, which limits the generalizability of the results to a large population. In addition to the lack of randomization, conclusions about causality are less definitive in such designs. Therefore, advanced statistical approaches were applied such as frequencies and means, to describe the values found in the data collected. Moreover, the mean scores were compared using a paired-sample t-test; because data sets are related (pre-test and post-test results belong to the same person).

6.7 Conclusion

Applying the best practice guide "ABC camerawork guide for Dr. photographer" improved physicians' photography technical skills significantly. Also, it expanded their awareness of ethical consideration and data management.

6.8 Acknowledgment

We acknowledge Dr. Lorraine LeGrand-Westfall for her generous contributions. We would also like to acknowledge Mr. Robert Derval, Mr. Daniel Heon, Mr. Tarek Gharzouzi, Mr. Vasilios Stefaros for being co-instructors during the workshop. Also, we would like to acknowledge Ms. Marie-Josée Bouchard and Ms. Patricia Wade for their assistance with the workshop logistics setup. We would like to thank Empay Photographe Studios for documenting the training activity through their lens.

Appendix 1:

Assignment Evaluation Form

Workshop session : ABC of Medical Photography (pre / post)

Participant :

Evaluator :

Evaluation of pedagogical scenarios where a physician has to take a medical photo of ;

Ear :

Face :

Skill	**Very poor (1)**	**Below average (2)**	**Average (3)**	**Above average (4)**	**Excellent (5)**
1. Handling the camera and the lens					
2. Adjusting the ISO					
3. Mastering the lighting exposure including flash use					
4. Adjusting the shutter speed according to the situation					
5. Understanding focus					
6. Choosing the right focal length according to the target being photographed					
7. Mastering patient positioning					
8. Using a proper background					
9. Respecting the patient privacy and confidentiality					
10. Explaining the purpose of the photograph and how it will be used					

Appendix 2 :

Questionnaire

Activity learning objectives

Q 1. What were your learning objectives for this activity in regard to the three main activity objectives

Objective 1: Apply ethical guidelines for medical-photo documentation.

Objective 2: Make quality medical photographs using the right tools.

Objective 3: Mastering necessary photography skills including DSLR cameras, lens adjustment, focal length, exposure, lighting, and patient positioning.

Q 2. Did this training meet your learning objectives?

Yes

No

If no, please specify why! ……..

Q 3. What are the key messages that you have gained during this activity regarding workshop's objectives in regard to these three messages

Message 1: Medical-photo documentation ethics.

Message 2: Quality medical photographs using the right tools.

Message 3: Technical photography skills.

Feedback about instructors

Q 4. Please specify your evaluation about instructors

1. Described and respected the objectives of their presentation

Totally disagree	Disagree	Agree	Totally agree

2. Facilitated the interaction with the participants

Totally disagree	Disagree	Agree	Totally agree

3. Mastered their subject

Totally disagree	Disagree	Agree	Totally agree

4. Respected the time allocated for the workshop

Totally disagree	Disagree	Agree	Totally agree

5. Presented the workshop as good quality educational material

Totally disagree	Disagree	Agree	Totally agree

6. Presented material relevant to my practice

Totally disagree	Disagree	Agree	Totally agree

7. Had good instructor skills

Totally disagree	Disagree	Agree	Totally agree

8. Their workshop was not biased

Totally disagree	Disagree	Agree	Totally agree

9. Declared their conflicts of interest

Totally disagree	Disagree	Agree	Totally agree

Feedback about the activity

Q 5. Please specify the influence of the workshop on your practice.

1. This workshop presented a message (s) relevant to my practice

Totally disagree	Disagree	Agree	Totally agree

2. This training confirms the techniques I use in my practice

Totally disagree	Disagree	Agree	Totally agree

3. This workshop encourages me to modify certain aspects of my photography skills

Totally disagree	Disagree	Agree	Totally agree

4. This workshop encourages me to gather more information about photography and keep using my camera

Totally disagree	Disagree	Agree	Totally agree

5. The presentation respected the stated objectives

Totally disagree	Disagree	Agree	Totally agree

Q 6. Please indicate your opinion about the knowledge assessment sessions

1. The case presentation approach allowed me to properly evaluate my skills.

Totally disagree	Disagree	Agree	Totally agree

2. The educational approach used in the hands-on session was appropriate for the session.

Totally disagree	Disagree	Agree	Totally agree

3. Interactive approach allowed me to consolidate my learning.

Totally disagree	Disagree	Agree	Totally agree

Q 7. Please indicate your satisfaction with the workshop activity in general

1. Choice and quality of the workshop location

Very unsatisfied	Unsatisfied	Satisfied	Very satisfied

2. Quality of meals provided during the break

Very unsatisfied	Unsatisfied	Satisfied	Very satisfied

3. Training room layout

Very unsatisfied	Unsatisfied	Satisfied	Very satisfied

4. Audiovisual quality

Very unsatisfied	Unsatisfied	Satisfied	Very satisfied

5. The organization of this activity respects the Code of Ethics of the Quebec Council for Continuing Professional Development

Very unsatisfied	Unsatisfied	Satisfied	Very satisfied

Q 8. What are the strengths of the workshop?

……

<u>Recommendations for future sessions</u>

Q 9. Do you have any specific comments for future workshops?

……

Q 10. In your opinion, what are the areas that need improvement for this activity?

……..

Q 11. What topics would you like to discuss in future sessions?

…….

References

1. Bhangoo P, Maconochie IK, Batrick N, Henry E. Clinicians taking pictures – a survery of current practice in emergency departments and proposed recommendations of best practice. J Emerg Med. 2005; 22:761-765.

2. Roberts EA, Troiano C, Spiegel JH. Standardization of Guidelines for Patient Photograph Deidentification. Ann Plast Surg. 2016; 76: 611-614.

3. Archibald DJ, Carlson ML, Friedman O. Pitfalls of nonstandardized photography. Facial Plast Surg Clin North Am. 2010; 18:253-266.

4. Hagan KF. Clinical photography for the plastic surgery practice-the basics. Plast Surg Nurs. 2008; 28:188-192.

5. Jemec BI, Jemec GB. Photographic surgery: standards in clinical photography. Anesthitic Plast Surg. 1986; 10: 177-180.

6. Hexsel D, Hexsel CL, Dal'Forno T, Silva AF, Siega C. Standardaized methods for photography in procedural dermatology using simple equipment. Int J Derma. 2017; 56:444-451.

7. May M. Photography for the physician. 1. A medical photographic set up. Eye Ear Nose Throat Mon. 1972(1); 51:28-32.

8. Swamy R, Most S. Pre- and postoperative portrait photography: standardized photos for various procedures. Facial Plast Surg Clin N Am. 2010; 245-252.

9. Ellenbogen R, Jankauskas S, Collini F. Achieving standardized photographs in aesthetic surgery. Plast Reconstr Surg 1990; 86 (5):955e61.

10. Galdino GM, DaSilva D, Gunter JP: Digital photography for rhinoplasty. Plast Reconstr Surg. 2002; 109:1421–1434.

11. Peck JJ, Roofe SB, Kawasaki DK. Camera and lens selection for the facial plastic surgeon. Facial Plast Surg Clin North Am. 2010; 18:223-230.

12. Burns K, Belton S. Clinicians and their cameras: policy, ethics and practice in an Australian tertiary hospital. Aust Health Rev 2013; 37:437.

13. Taheri A, Yentzer B, Feldman S. Focusing and depth of field in photography: application in dermatology practice. Skin Research and Tech. 2013; 19:394-397.

14. Sheridan P. Practical aspects of clinical photography: part 1- principles, equipment and technique. ANZ J Surg. 2013, 83:188-191.

15. Sen Z, Kaya B, Serel S, Saglam H, Can Z. Photographic standardization in esthetic surgery. Ankara Univ Tip Fak. 2005, 85:5-10.

16. Yavuzer R, Smirnes S, Jackson IT. Guidelines for standard photography in plastic surgery. Ann Plast Surg. 2001, 46:293-300.

17. Hill K. Consent, confidentiality and record keeping for the recording and usage of medical images. J Visual Commun Med. 2006, 29:76-79.

18. Ong C T, Yap J, Wai Y, Ng QX. A review of oculoplastic photography: a guide for clinician photographers. Cureus. 2016, 8:e733.

CHAPTER SEVEN: SUMMARY

7.1 Overall Discussion

Literature showed that a professional level digital camera with a supplementary lighting source can aid physicians in taking acceptable photographs [22]. However, the art of medical photography depends on the photographer more than the equipment. Studies presented that broad knowledge of photography and camera mechanism is the key element to a quality photograph [22, 23].

Furthermore, studies showed that ethical consideration is a matter of good practice to obtain a successful photograph and use it without breaching patient's privacy [24, 25]. Nevertheless, most physicians are unaware of the absolute need to obtain proper consents, and protect their patients' confidentiality [24-26]. A study done by Burns and their team highlighted that most clinicians are not fully aware of the legality and copyright concerning medical photographs [26].

Although some publications addressed different personal inconclusive standards and protocols for medical photography, none was validated or tested [27-34]. Also, literature concluded that standardized photography may enhance the quality of medical care provided [35, 36]. However, there is a definite lack of knowledge about technical aspects, data management, ethical issues and legal aspects of medical photography using modern DSLR cameras [10].

Our study was successful in investigating the missing knowledge in this area, and developing and testing a best-practice guide to enhance physicians' photography skills. The "ABC camerawork guide for Dr. photographer" which is the fruit of the whole project, had notably improved overall physicians' skills to capture photographs.

To reach such a successful outcome, results from all study phases were emerged through a careful triangulation at different levels; across the literature review, systematic review and qualitative elements and across qualitative and quantitative elements. This was done while all data sets were analyzed separately.

Interpreting and integrating findings from the literature review, the systematic review, and the mixed methods study phases helped better identifying essential best-practice components, and evaluating the guide as well. Specifically, triangulation approach was conducted in three phases:

- A matrix was initially constructed from knowledge and elements represented in the literature and the systematic review results. The latter focused on two main global themes; which are technical skills and ethical consideration.
- Themes resulted from the systematic review were used to construct an interview guide; which was the foundation of a qualitative study phase. The latter resulted in a single list of elements, issues and facilitators to create a best-practice photography guide.
- The photography guide was tested through quantitative studies that involved a quasi-experimental study and a survey. The agreement between different study phases was used for the best-practice evaluation.

7.2 Overall Conclusion

The present thesis yielded new knowledge of technical and ethical issues that are important in the era of digital photography. It also showed the importance of understanding the photo making mechanism. The thesis presented an applicable guide

that facilitated physicians' roles as photographers and improved their practice in a way that copes with the current technology.

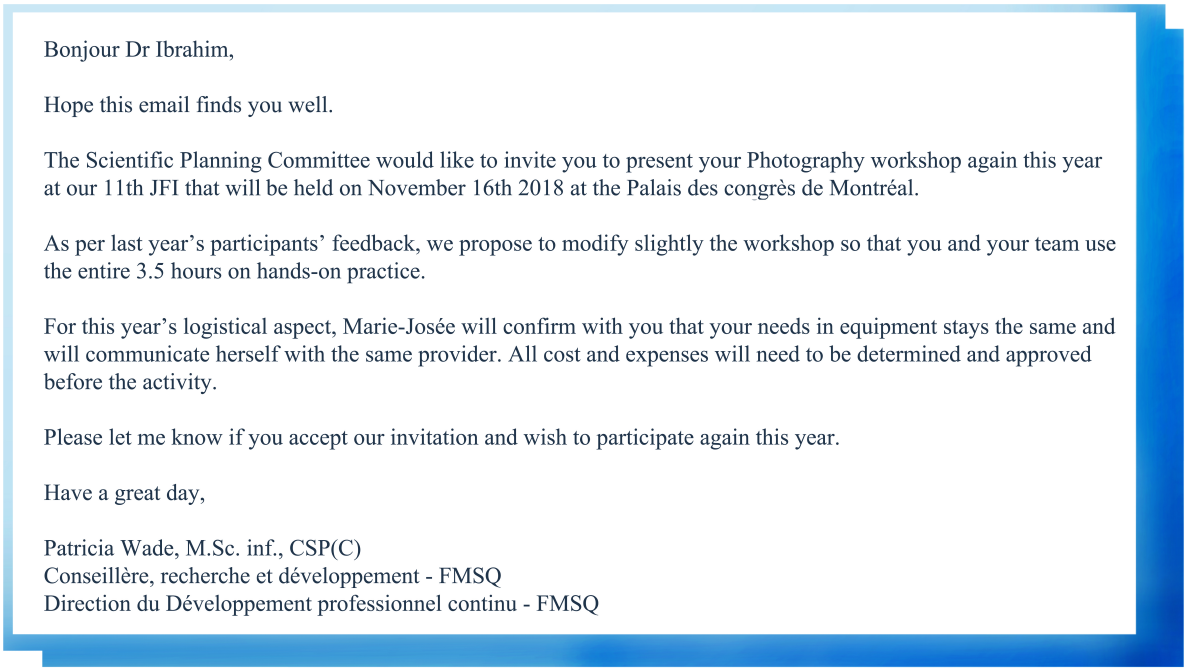
7.3 Closing Notes

Although modern computerized cameras have been smoothing the procedure of taking medical photographs, the fundamental element is the doctor photographer who should have the needed knowledge of both camera techniques and clinical procedures. *"Photography is not a lens but eye, not a business but art" – Farid F Ibrahim*.

The final outcomes of this thesis shed some light on one of the main challenges that physicians face in their current medical practice, namely medical photography; and proposed a validated guide that could be followed to overcome this challenge. Despite the successful end-results, the limited number of participants restricts our conclusions. Therefore, a quantitative study to further test and validate the "ABC camerawork guide for Dr. photographer" should be considered, to involve more participants, so that results could be more generalizable.

An invitation from the FMSQ to present the best-practice guide through a hands-on workshop at the 11th JFI was received, and gracefully accepted [Fig 1]. This will allow us to test the guide on a larger scale and help generalize the results.

Figure 1:



Bonjour Dr Ibrahim,

Hope this email finds you well.

The Scientific Planning Committee would like to invite you to present your Photography workshop again this year at our 11th JFI that will be held on November 16th 2018 at the Palais des congrès de Montréal.

As per last year's participants' feedback, we propose to modify slightly the workshop so that you and your team use the entire 3.5 hours on hands-on practice.

For this year's logistical aspect, Marie-Josée will confirm with you that your needs in equipment stays the same and will communicate herself with the same provider. All cost and expenses will need to be determined and approved before the activity.

Please let me know if you accept our invitation and wish to participate again this year.

Have a great day,

Patricia Wade, M.Sc. inf., CSP(C)
Conseillère, recherche et développement - FMSQ
Direction du Développement professionnel continu - FMSQ

Figure 1: FMSQ invitation for the 11th JFI, to present the medical photography hands-on workshop

References

1. Clarke G. The Photograph (Oxford History of Art). Oxford, UK: Oxford University Press, 1997.

2. Stannard T. The history of medical photography. Soc Soc Hist Med Bull 1980; 27: 33–43.

3. Thorburn AL. Alfred Francois Donne, 1801-1878, discoverer of Trichomonas vaginalis and of leukaemia. Br J Vener Dis 1974; 50: 377–80.

4. Burns SB. Early medical photography in America (1839-1883): III. The daguerrean era. N Y State J Med 1979; 79: 1256–68.

5. Shenoy R, Molenda MA, Mostow EN. The introduction of skin self-photography as a supplement to skin self-examination for the detection of skin cancer. J Am Acad Dermatol 2014; 70: e15.

6. Tsai J, Liao HT, Wang WK et al. A safe and efficient method for intra-operative digital photography using a waterproof case. J Plast Reconstr Aesthet Surg 2011; 64: e253–8.

7. Emous M, Westerterp M, Wind J, Eerenberg JP, van Geloven AA. Registering the critical view of safety: photo or video? Surg Endosc 2010; 24: 2527–30.

8. Santucci KA, Hsiao AL. Advances in clinical forensic medicine. Curr Opin Pediatr 2003; 15: 304–8.

9. Al-Hadithy N, Gikas PD, Al-Nammari SS. Smartphones in orthopaedics. Int Orthop 2012; 36: 1543–7.

10. Harting MT, DeWees JM, Vela KM, Khirallah RT. edical photography: current technology, evolving issues and legal perspectives. Int J Clin Pract. 2015 Apr;69 (4):401-409.

11. Hexsel D, Hexsel CL, Dal'Forno T, Silva AF, Siega C. Standardaized methods for photography in procedural dermatology using simple equipment. Int J Derma. 2017; 56:444-451.

12. Galdino GM, Vogel JE, Vander Kolk CA: Standardizing digital photography: it's not all in the eye of the beholder. Plast Reconstr Surg. 2001; 108:1334–1344.

13. May M. Photography for the physician. 1. A medical photographic set up. Eye Ear Nose Throat Mon. 1972(1); 51:28-32.

14. Segal J, Sacopulos MJ. Photography consent and related legal issues. Facial Plast Surg Clin North Am. 2010; 18:237-244.

15. Swamy R, Most S. Pre- and postoperative portrait photography: standardized photos for various procedures. Facial Plast Surg Clin N Am. 2010; 245-252.

16. Hagan KF. Clinical photography for the plastic surgery practice-the basics. Plast Surg Nurs. 2008; 28:188-192.

17. Uzun M, Bulbul M, Toker S, Beksac B, Kara A. Medical Photography: principles for orthopedics. J Ortho Surg and Res. 2014; 9:23.

18. Kevin R. Harris, David W. Eccles, Paul Ward, James Whyte. A Theoretical Framework for Simulation in Nursing: Answering Schiavenato's Call. Journal of Nursing Education. 2013; 52(1):6-16.

19. John W. Creswell, Michael D. Fetters, Nataliya V. Ivankova. Designing a mixed methods study in primary care. Ann Fam Med. 2004 Jan; 2(1): 7–12.

20. Sandelowski M. Whatever happened to qualitative description? Res Nurs Health. 2000; 23(4):334-340.

21. Neergaard M, Olesen F, Andersen R, Sondergaard J. Qualitative description - the poor cousin of health research? BMC Med Res Methodol. 2009; 16; 9:52.

22. Meijer PP, Karlsoon J, LaPrade RF, Verhaar JA, Wijdicks CA. A guideline to medical photography: a perspective on digital photography in an orthopaedic setting. Knee Surg Sports Traumatol Arthosc. 2012; 20: 2606-2611.

23. Kamath SB, Nithyanandam S, Vasu U, Raghavendra R. Tips in ophthalmic photography. Indian J Ophthalmol. 2012; 60-74.

24. Kunde L, McMeniman E, Parker M. Clinical photography in dermatology: Ethical and medico-legal considerations in the age of digital and smartphone technology. Aust J Derma. 2013; 54:192-197.

25. Hill K. Consent, confidentiality and record keeping for the recording and usage of medical images. J Visual Commun Med. 2006, 29:76-79.

26. Burns K, Belton S. Clinicians and their cameras: policy, ethics and practice in an Australian tertiary hospital. Aust Health Rev 2013; 37:437.

27. Sheridan P. Practical aspects of clinical photography: part 1- principles, equipment and technique. ANZ J Surg. 2013, 83:188-191.

28. Sen Z, Kaya B, Serel S, Saglam H, Can Z. Photographic standardization in esthetic surgery. Ankara Univ Tip Fak. 2005, 85:5-10.

29. Yavuzer R, Smirnes S, Jackson IT. Guidelines for standard photography in plastic surgery. Ann Plast Surg. 2001, 46:293-300.

30. Hill K. Consent, confidentiality and record keeping for the recording and usage of medical images. J Visual Commun Med. 2006, 29:76-79.

31. Ong C T, Yap J, Wai Y, Ng QX. A review of oculoplastic photography: a guide for clinician photographers. Cureus. 2016, 8:e733.

32. Martinez JC. Standardized photography in facial reconstructive surgery: clinical pearls to simplify a complicated task. Dermatol Surg. 2011; 37: 82-85.

33. Vallarelli AFA. Criteria for submitting photos. An Bras Dermatol. 2011; 86: 212-214.

34. Kaliyadan F, Manoji J, Venkitakrishnan S. Basic digital photography in dermatology. Indian J Dermatol Venereol Leprol. 2008; 74: 532-536.

35. Accetta P, Accetta J, Kostecki J. The use of digital cameras by US dermatologists. J Am Acad Dermatol. 2013; 69: 837-838.

36. Kaliyadan F. Digital photography for patient counseling in dermatology – a study. J Eur Acad Dermatol Venereol. 2008; 22: 1356-1358.