Pregnancy Screening Strategies
for Diagnostic
Nuclear Medicine Procedures

Daphne J James
GradCert PTT, Ass Dip in Nuclear Medicine Technology

Thesis by publication submitted for the degree
Doctor of Philosophy (Medical Radiation Science)
Faculty of Health and Medicine
The University of Newcastle
September 2014
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ACKNOWLEDGEMENT OF AUTHORSHIP

I hereby certify that this thesis is in the form of a series of published papers of which I am a joint author. I have included as part of the thesis a written statement from each co-author, endorsed by the Faculty Dean (research Training), attesting to my contribution to the joint publications.

Daphne James
ACKNOWLEDGEMENTS

First and foremost I would like to express my sincere thanks to my supervisors, Associate Professor Helen Warren-Forward and Mr Paul Cardew. They have given me an incredible amount of support and guidance during my PhD studies. They provided their time, knowledge, and advice which helped me to stay motivated and to achieve what sometimes felt like an insurmountable task. I would especially like to thank Helen for acting not only as my supervisor, but as an academic mentor and friend.

I would also like to thank all those who have contributed to this work and have aided and supported me throughout my PhD studies; in particular, my academic colleagues in the School of Health Sciences and my professional colleagues working in nuclear medicine. Your friendship and encouragement has helped to make this journey a positive and fulfilling experience.

Finally, I would like to thank my family and friends for providing their love and support - a huge thank you to my partner, Darren; my children, Matthew, Lachlan and Claire; and to my parents, Jill and Keith. You have all encouraged me, believed in my ability, and allowed me the time I needed to focus on my studies. I am truly grateful to you all.
THESIS PUBLICATIONS AND PRESENTATIONS

Manuscripts published in peer reviewed journals


Manuscripts submitted to peer reviewed journals

Peer reviewed systematic review protocol


Peer Reviewed Conference Publications


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LIST OF ABBREVIATED TERMS

\(^{18}\text{F-FDG}\) \(^{18}\text{Fluorine-fluorodeoxyglucose}\)

\(^{99m}\text{Tc}\) \(^{99m}\text{Technetium}\)

ACR American College of Radiology

ACT Australian Capital Territory

ALARA As Low As Reasonably Achievable

ANZSNM Australian and New Zealand Society of Nuclear Medicine

ARPANSA Australian Radiation Protection and Nuclear Safety Agency

ARSAC Administration of Radioactive Substances Advisory Committee

BMI Body mass index

BNMS British Nuclear Medicine Society

CT Computed Tomography

hCG Human Chorionic Gonadotrophin

IAEA International Atomic Energy Agency

ICRP International Commission on Radiation Protection

IVF In vitro fertilisation

LMP Last menstrual period

mGy milliGray

mSv milliSievert

MBq megabecquerel

NCRP National Council on Radiation Protection and Measurements

NMS Nuclear Medicine Scientist

NMT Nuclear Medicine Technologist

NSW New South Wales

OSCC Oxford Study of Childhood Cancers

PET Positron Emission Tomography

QLD Queensland

SNMMI Society of Nuclear Medicine and Molecular Imaging

SPECT Single Photon Emission Computed Tomography

UNSCEAR United Nations Scientific Committee on the Effects of Atomic Radiation

VIC Victoria
ABSTRACT

Nuclear medicine involves the use of ionising radiation to image the physiological functions of the body and to treat certain diseases. Ionising radiation has the potential to cause biological harm and foetal tissue is particularly sensitive especially in the early stages of pregnancy. Although diagnostic nuclear medicine procedures use relatively low levels of radiation, there is still a risk to a foetus if inadvertently exposed during maternal examinations. National and international radiation protection documents recommend that all women of childbearing age be questioned about their pregnancy status prior to any procedure that uses ionising radiation. However, they do not provide any clear guidelines on what constitutes childbearing age, or how to question the patient prior to diagnostic nuclear medicine procedures.

This thesis reports on four interconnected research phases: two literature reviews (systematic and narrative), an interview study, a cross-sectional survey, and a Delphi study. The systematic review on the accuracy of pregnancy screening strategies to identify early pregnancy revealed that serum and urine HCG pregnancy tests are highly sensitive. However, urine tests have a high false-negative rate when used in the early stages of pregnancy. The review also revealed that self-assessment of pregnancy is reliable, particularly in the absence of pregnancy. A narrative review of formal methods of consensus development identified the Delphi Technique as the best method for development of consensus statements for identifying/assessing early pregnancy in women patients prior to diagnostic NM scans.

Phase two of the research involved a series of semi-structured interviews to investigate current practice and identify any associated problems or difficult to question groups, such as teenagers. The interview findings were used to develop a questionnaire for a National online cross-sectional survey of nuclear medicine personnel in Australia and New Zealand (Phase three). Both studies revealed wide variations in current practice which may lead to inadvertent foetal irradiation. The studies highlighted the need for a consistent approach and the development of consensus guidelines.
Finally, a three-round Delphi study was conducted to develop consensus statements regarding questioning patients prior to diagnostic nuclear medicine procedures. The age range for questioning was defined by consensus as 12-55 years. A method for questioning patients was developed which included advice regarding previously identified difficult to question groups. A flowchart was created as a visual aid.

Identification of pregnant and potentially pregnant women prior to diagnostic nuclear medicine procedures is imperative to avoid foetal exposure to ionising radiation. This research identified the lack of a consistent approach and developed consensus guidelines for questioning patients about their pregnancy status. The implementation of these consensus guidelines into nuclear medicine practice will help accurately identify pregnancy and minimise any unnecessary foetal irradiation.