

THE ACCURACY OF ULTRASOUND, THERMOGRAPHY, PHOTOGRAPHY AND SUB-EPIDERMAL MOISTURE AS A PREDICTOR OF PRESSURE ULCER PRESENCE - A SYSTEMATIC

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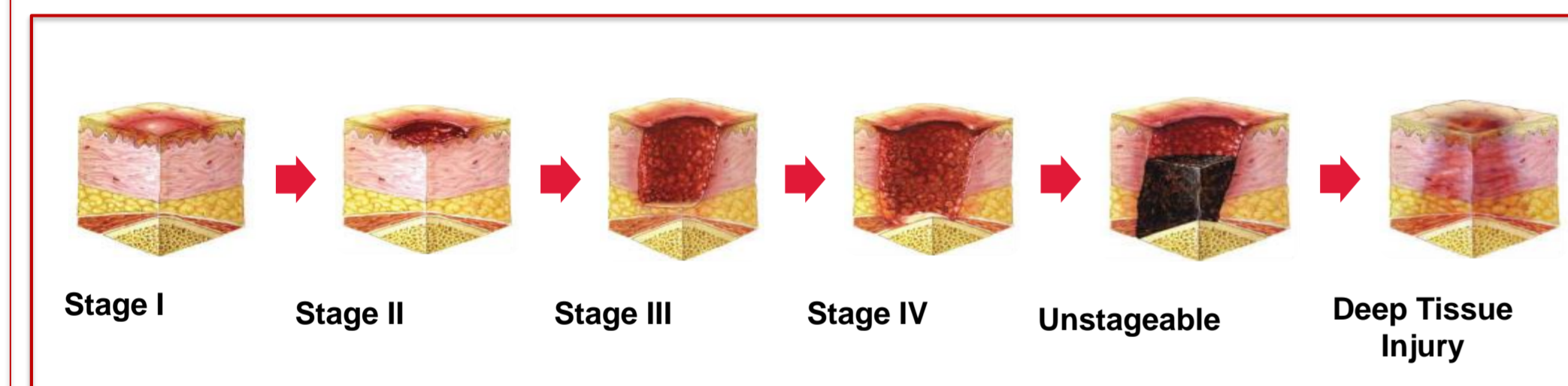
1. INTRODUCTION

- In Ireland mean pressure ulcers prevalence and incidence, is 16% and 11% respectively¹.
- A challenge with current grading tools is the lack of ability to detect changes in the deeper tissues, when no visible changes are evident at the skin level.
- Novel methods, such as sub-epidermal moisture (SEM), ultrasound, thermography and photography, in identifying early pressure ulcer development need to be further analysed.

2. DEFINITION OF TERMS

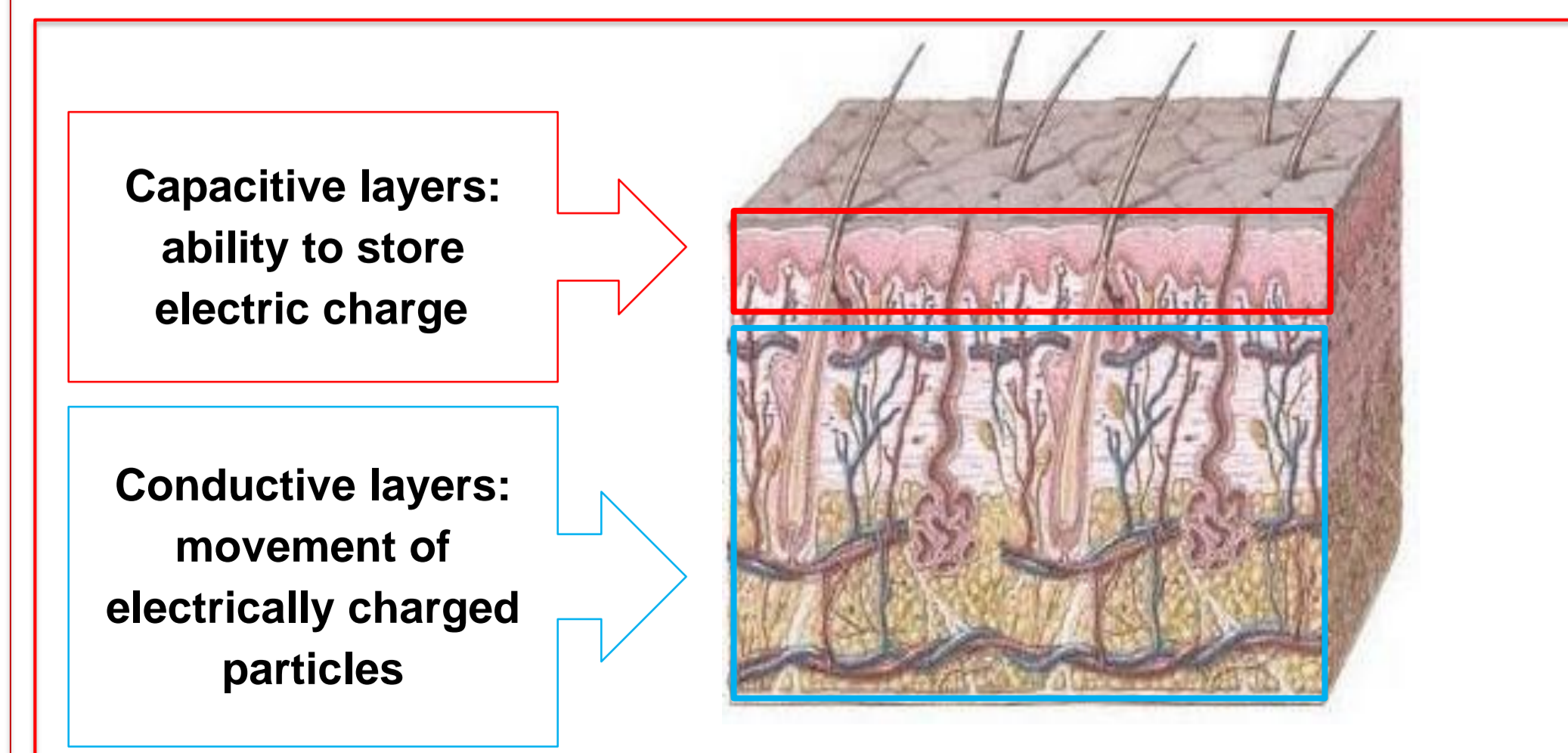
Pressure Ulcers are areas of skin damage that can include underlying tissue (figure 1), and develop normally over bony prominences, as a result of pressure alone or pressure in conjunction with shear².

Figure 1: Pressure Ulcer Staging



Sub-epidermal Moisture is related to the quantity of skin/tissue water^{3,4,5}. SEM can be measured using surface electrical capacitance⁵ which is determined by the impedance of the skin to electrical forces, and can reflect the presence of oedema/water content of the epidermal and sub-epidermal tissues⁵(figure 2).

Figure 2: Capacitive and Conductive layers of the tissues



3. REVIEW QUESTION

What is the accuracy of SEM, ultrasound, thermography and photography in determining pressure ulcer presence?

4. OBJECTIVES

- To establish the clinical significance of ultrasound, thermography, photography and SEM.
- To identify the accuracy of ultrasound, thermography, photography and SEM in determining tissue damage and pressure ulcer presence.
- To determine the relative accuracy of one method of assessment namely, SEM, ultrasound, thermography and photography over another.
- To make recommendations for practice pertaining to assessment of early pressure ulcer damage.

5. INCLUSION & EXCLUSION CRITERIA

This systematic review included all quantitative original research studies, both animal and human studies. No other limitations were applied.

6. SEARCH STRATEGY

Search terms:

- Pressure ulcer*(s), decubitus ulcer(s), bed sore(s), pressure sore(s); bed ulcer(s), pressure area*(s);
- Thermography, thermology, infrared imaging;
- Ultrasound, ultrasonic imaging, image(s), sonography; ultrasonography;
- Photograph*, digital image(s), imaging; digital imaging (MH), photography MH;
- Sub-epidermal moisture, subepidermal moisture.

Databases:

- The Cochrane Wounds Group Specialised Register;
- The Cochrane Central Register of Controlled Trials (CENTRAL) (The Cochrane Library) (latest issue);
- Ovid MEDLINE (1946 to present);
- Ovid EMBASE, Elsevier version (1974 to present);
- EBSCO CINAHL (1982 to present).

Clinical trials registries:

- ClinicalTrials.gov;
- WHO International Clinical Trials Registry (ICTR);
- The EU Clinical Trials Register

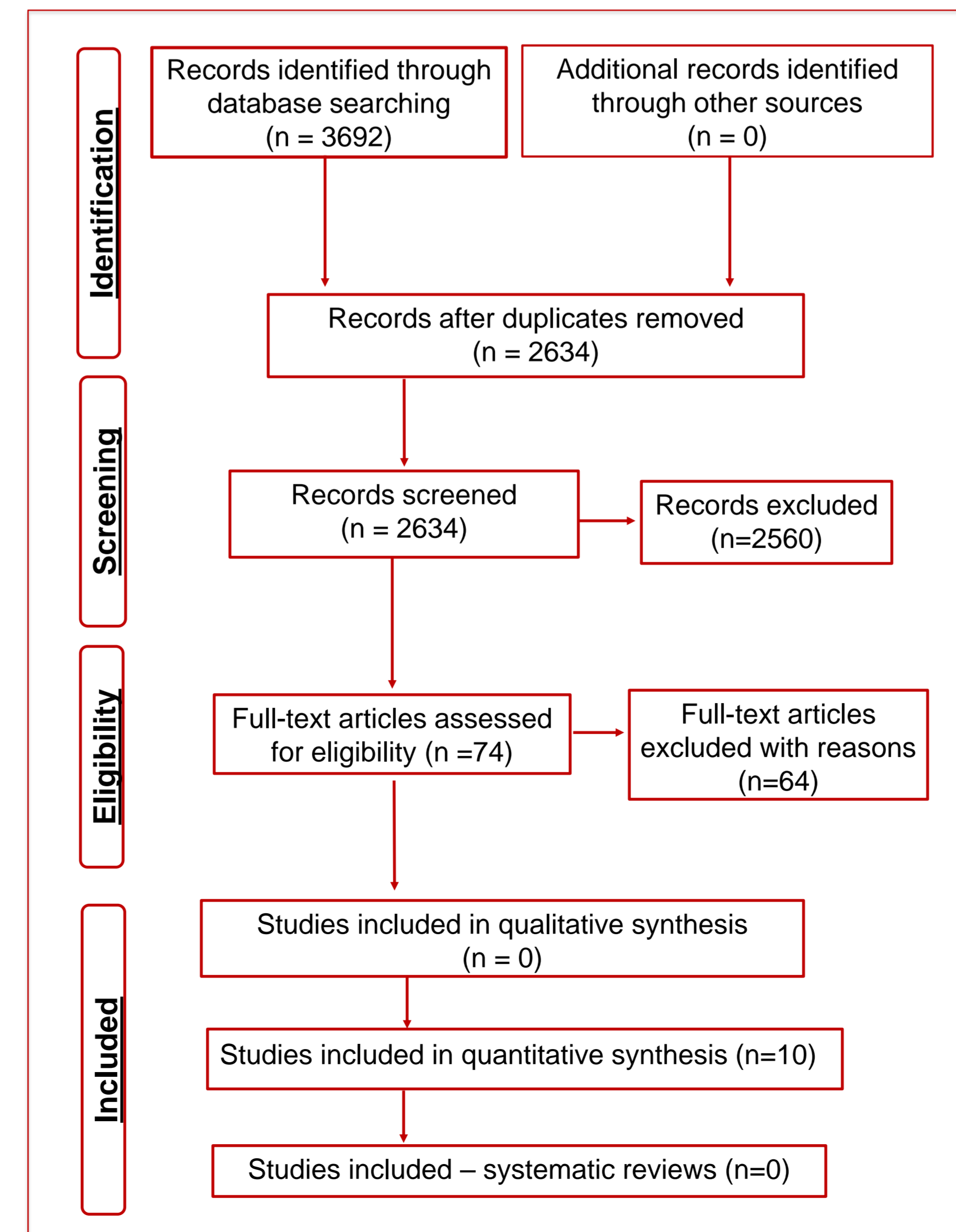
7. DATA EXTRACTION & QUALITY APPRAISAL

- The information extracted included: author, date of study, title, source/journal, study geographical location, research question, aim/objectives, study type, design, outcome measures, care setting, inclusion/exclusion criteria, sample size, patient characteristics, study procedure details, device characteristics, data analysis, results, conclusions.
- For quality appraisal of the included studies the EBL Critical Appraisal Checklist was employed.

8. DATA SYNTHESIS AND ANALYSIS

Initially a structured narrative summary of the studies reviewed was presented. In relation to data analysis this was also done narratively based on the outcome measures.

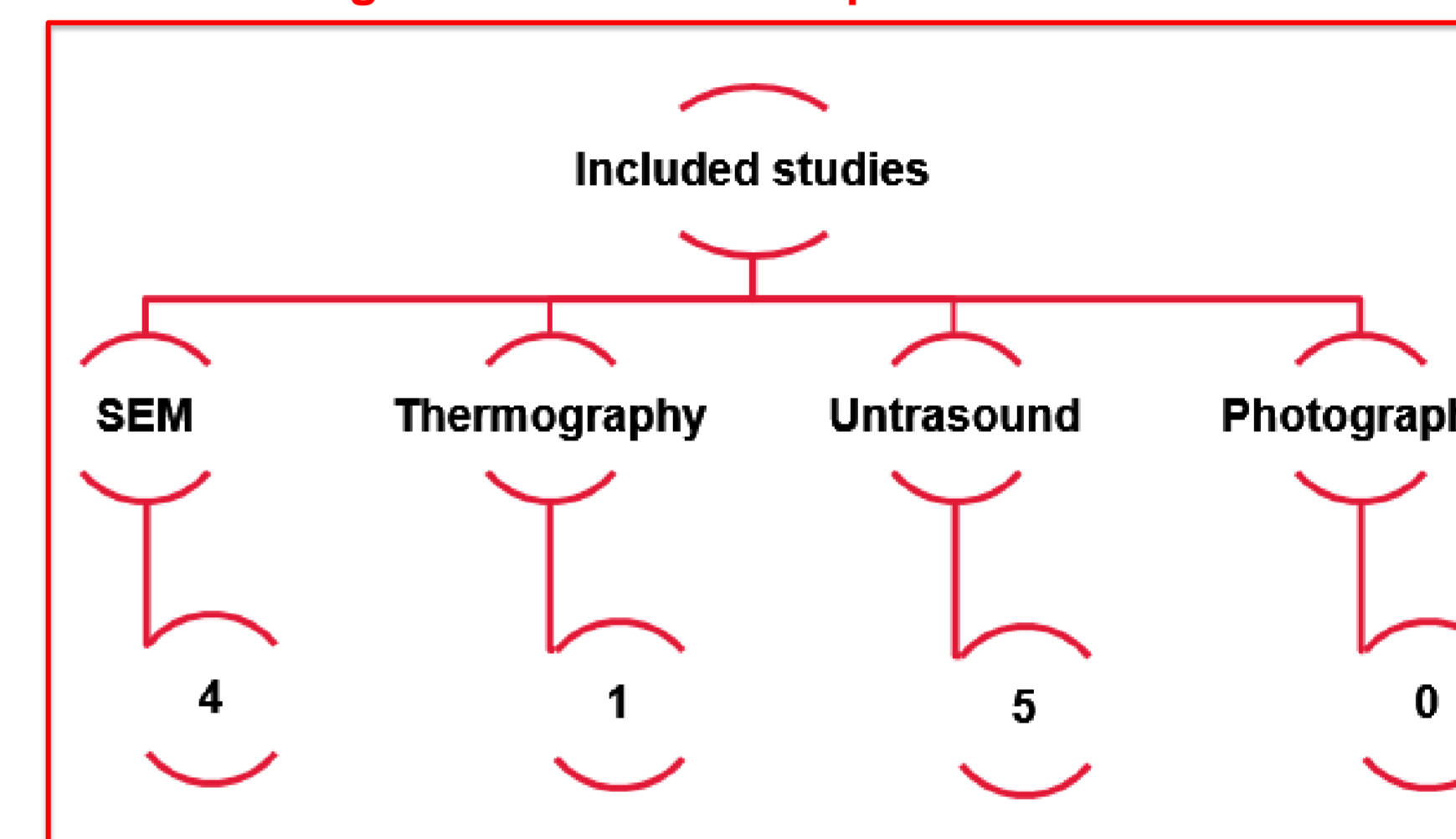
Figure 3: Search Strategy Flow Diagram Adapted from PRISMA³



9. RESULTS

Ten studies were included in the review (figure 4).

Figure 4: Number of Papers Included



9.1 PHOTOGRAPHY

- Photography was not found to be a method, which allowed for the prediction of early pressure ulcer presence.

9.2 SEM

- Across the studies a total of 87 pressure ulcers developed in 51 subjects. Pressure ulcers ranged from stage I to stage II+.
- SEM was a method that allowed for the early detection of tissue damage.
- Higher SEM measures corresponded to increased skin damage.
- SEM measurements were able to predict the development of skin damage which then became evident visually, one week later.

9.3 ULTRASOUND

- All of the ultrasound images of suspected areas of pressure ulcer damage showed regions with abnormal patterns.
- Ultrasound imaging was able to detect pockets of fluid/oedema at different levels of the skin layers that were comparable to skin damage.
- In the majority of studies, the heels and sacrum were the most common anatomical locations where pressure ulcers developed.

9.4 THERMOGRAPHY

- One study was retrieved exploring thermography.
- The ability of thermography to predict pressure ulcer presence varied between 22% and 39%
- Thermography was more likely to detect subjects at high risk of developing pressure ulcer when compared to the Braden Scale risk assessment tool..

10. DISCUSSION

The included studies showed that SEM and ultrasound are accurate methods in early prediction of tissue damage and in predicting the subsequent development of visual pressure ulceration one week after initial assessment. Furthermore, measures obtained from SEM and ultrasound, corroborate the theory that pressure ulcers start developing on the deep tissues and not at the surface of the skin.

11. CONCLUSION

SEM and ultrasound are promising in the detection of early tissue damage and pressure ulceration; however, these methods should be further studied to clarify their potential for use more widely in pressure ulcer prevention strategies.

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