Trends in gel dosimetry: Preliminary bibliometric overview of active growth areas, research trends and hot topics from Gore's 1984 paper onwards

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Trends in gel dosimetry: Preliminary bibliometric overview of active growth areas, research trends and hot topics from Gore's 1984 paper onwards

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Abstract. John Gore's seminal 1984 paper on gel dosimetry spawned a vibrant research field ranging from fundamental science through to clinical applications. A preliminary bibliometric study was undertaken of the gel dosimetry family of publications inspired by, and resulting from, Gore's original 1984 paper to determine active growth areas, research trends and hot topics from Gore's paper up to and including 2016. Themes and trends of the gel dosimetry research field were bibliometrically explored by way of co-occurrence term maps using the titles and abstracts text corpora from the Web of Science database for all relevant papers from 1984 to 2016. Visualisation of similarities was used by way of the *VOSviewer* visualisation tool to generate cluster maps of gel dosimetry knowledge domains and the associated citation impact of topics within the domains. Heat maps were then generated to assist in the understanding of active growth areas, research trends, and emerging and hot topics in gel dosimetry.

1. Introduction

The use of radiation sensitive gels for the purposes of radiation dosimetry is predominantly as a result of the work originally undertaken by John Gore *et al* in 1984 [1] who showed the ferrous sulfate chemical dosimeter, initially developed by Fricke and Morse [2], could be probed by nuclear magnetic relaxometry and hence by magnetic resonance imaging (MRI). Gore's seminal 1984 paper on gel dosimetry spawned a vibrant research field ranging from fundamental science through to clinical applications [3-5].

Undertaking bibliometric studies of published research papers in a specific field allows the deduction of trends over a specific period and in so doing enable conclusions to be drawn regarding different subfields or research areas [6]. A recent study was undertaken by the author to investigate the radiation dosimetry research field with a view to determining active growth areas, research trends and hot topics from 2011-2015 [7].

A preliminary bibliometric study was undertaken of the gel dosimetry family of publications inspired by, and resulting from, Gore's original 1984 paper [1]. The Web of Science database was used to investigate the themes and trends of the gel dosimetry research field to generate cluster maps of knowledge domains and the associated citation impact of topics within the domains. The methodology used so-called term maps to visualize the totality of the gel dosimetry research field from 1984 up to 2016. A term map is a two-dimensional representation of a research field in which strongly related terms are located close to each other and less strongly related terms are located further away from each other with the term map providing an overview of the structure of a field [8]. Different areas in a map

correspond with different subfields. The term maps were used to assist in the understanding of active growth areas of the gel dosimetry research field and associated research trends and emerging hot topics.

2. Methods

The titles and abstracts text corpora, corresponding to 1578 publications, was downloaded from the Web of Science database for the period from 1984 to 2016. Title and abstract information for each publication was merged into a single text corpus file for the period under consideration and analysed using the *VOSviewer* visualization tool (www.vosviewer.com) [8-11]. With an emphasis on visualization, the *VOSviewer* computer program employs a text mining function and associated natural language processing to identify relevant noun phrases in combination with a unified mapping and clustering approach to examine network co-citation data and the co-occurrence of scientific terms. The interactive functionality of the program provides an accessible and hands-on way to explore networks of bibliometric data such as citation counts and/or the co-occurrence relationships among key terms and concepts.

3. Results

3.1 Co-occurrence of terms

Figure 1 shows a co-occurrence term map, figure 2 shows a co-occurrence term density map and figure 3 shows a co-occurrence term cluster map. In figure 1, each term is represented by a circle, where the diameter of the circle and size of its label represent the frequency of the term, its proximity to another term indicates the degree of relatedness of the two terms, and its colour represents the cluster to which it conceptually belongs. The terms are spatially interrelated in multidimensional space and the figure is limited to a 2-D representation with some relationships between terms not be readily apparent. The map can be seen to contain 5 clusters of co-occurring terms. The red cluster is predominately associated with the formulation, composition and properties of gel dosimeters, the green cluster is predominately associated with dosimetry, the blue cluster is predominately associated with MRI and associated topics, the yellow cluster is predominately associated with tissue and radiological properties, and the purple cluster is predominately associated with optical properties and imaging.

3.2 Highly cited terms

Figure 4 is a co-occurrence citation impact heat map indicating the relative citation impact of the terms relative to an average citation impact for all publications in the map. Presented data is normalised to take into account the year of publication as older publications have more opportunity for being cited. Red indicates an above average citation impact, blue a below average citation impact and green an average citation impact. Figure 4 indicates that more highly cited publications occur generally on the right of the figure.

4. Discussion and Conclusions

A number of specific research topics show significant active growth and may be considered to be emerging or hot topics.

The variation in the citation impact across Figure 4 is noticeably with topics on the right of the figure having greater impact in the green (dosimtry) domain and decreasing through the red (formulation, composition and properties of gel dosimeters) and blue (MRI and associated topics) domains. There are significant variations in citation practices with, for instance, much larger reference lists in molecular biology than in mathematics resulting in publications in molecular biology on average being cited more frequently than publications in mathematics. This variation in citation practice may account for aspects of that observed in the purple domain.

Further work is continuing beyond this preliminary investigation of active growth areas and research trends to consider the past development of research areas in gel dosimetry with the aim of further identifying current and potential future so-called ‘hot research topics’.

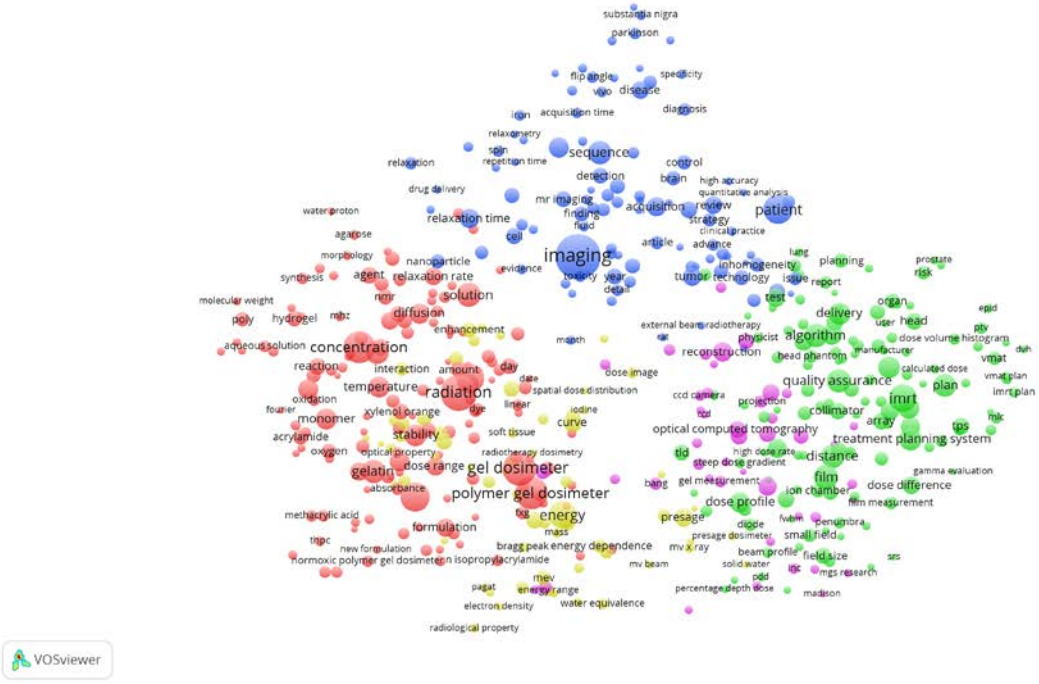

Figure 1. Co-occurrence term map.

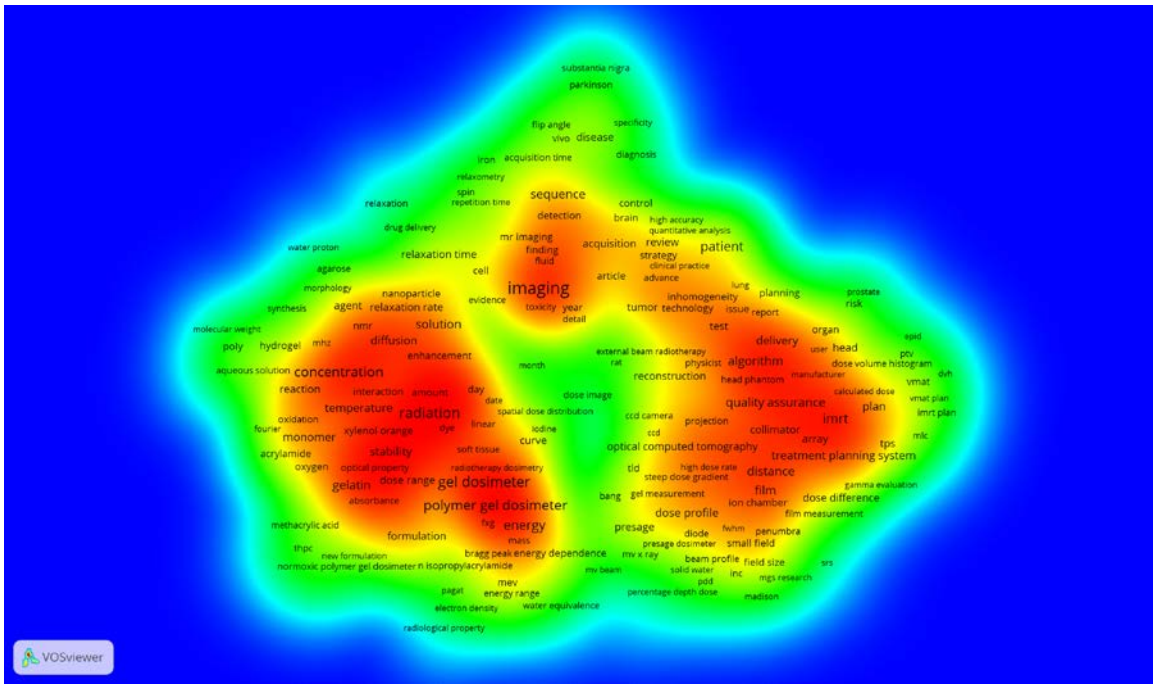

Figure 2. Co-occurrence term density map.

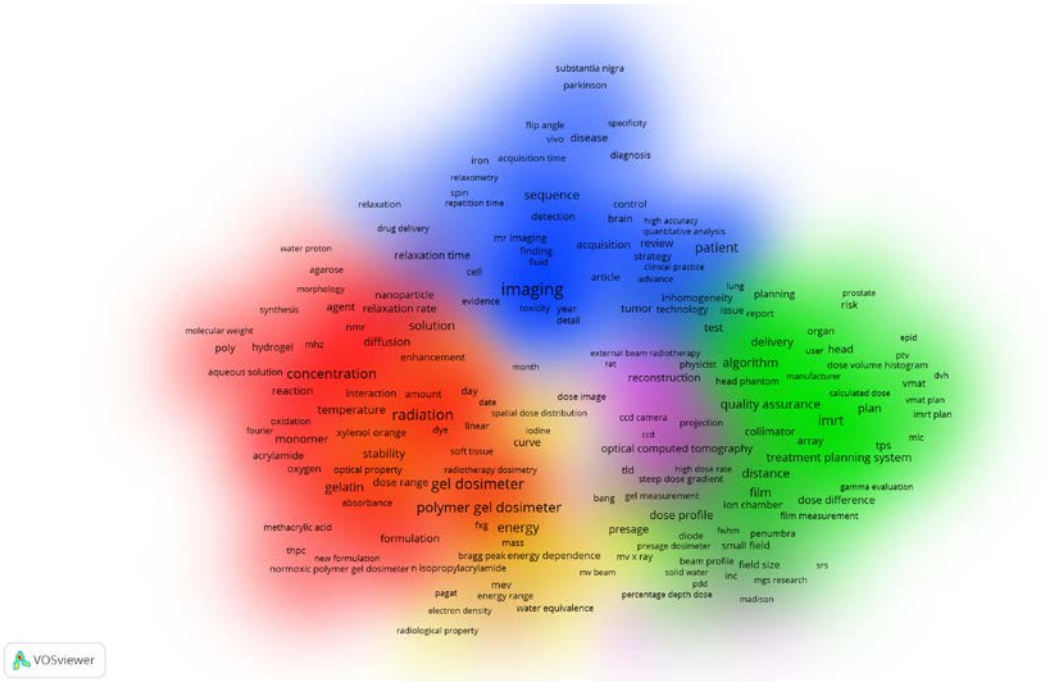

Figure 3. Co-occurrence term cluster map.

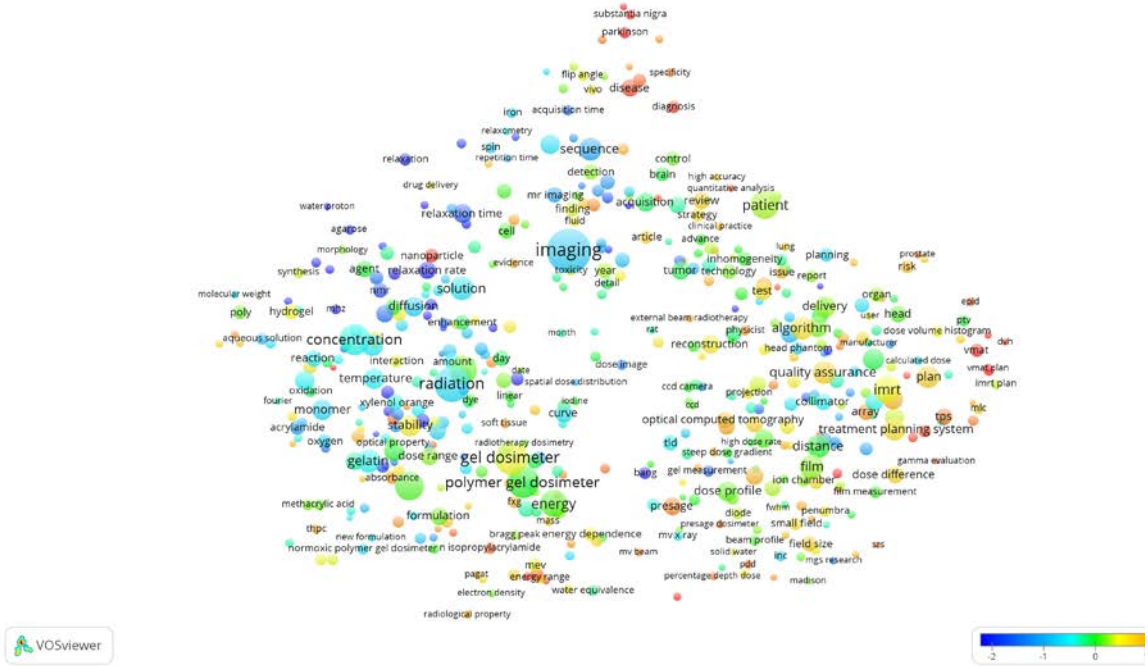

Figure 4. Co-occurrence citation impact heat map

5. References

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