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A rapid review of variation in the use of dental general anaesthetics in children

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Abstract

Introduction

The use of dental general anaesthetics (DGAs) remains a cause for concern due to additional strains placed on health services. There are numerous factors influencing the prevalence and use of DGAs, and understanding these is an important first step in addressing the issue.

Aim

Conduct a rapid review of current peer reviewed and grey literature on the variation in the use of dental general anaesthetics in children.

Methods

Electronic searching using MEDLINE via Ovid covering DGA articles from 1998 onwards, written in English. Publication types included primary and secondary sources from peer reviewed journals and reports, as well as grey literature.

Results

From 935 results, 171 articles were included in the final review. Themes emerging from the literature included discussions of DGA variation, variations in standards of service provision by health services, and the socio-demographic and geographical characteristics of children. Prominent

socio-demographic and geographical characteristics included age, other health conditions, ethnic and cultural background, socio-economic status and deprivation, and geographical location.

Conclusions

This review identified numerous variations in the patterns associated with DGA provision and uptake at both a health service and individual level. The findings demonstrate the complicated and multifaceted nature of DGA practices worldwide.

Key points

- The continuing high DGA rates are a concern amongst policy makers
- At the health service level there are varying standards being applied to DGA pre-assessments, as well as compliance with guidelines for administering DGAs
- Socio-demographic characteristics act as key predictors of DGA use, with many children facing multiple burdens due to combinations of ethnic background, deprivation, and geographical location

Word count: 4,074

Introduction

In the United Kingdom, dental general anaesthetics (DGAs) have been carried out in secondary care settings following the publication of the 2000 report 'A Conscious Decision', a review of general anaesthetic use in primary dental care.[1] Hospital admissions for extractions due to dental caries were estimated to cost £30 million in 2012/13, rising to £35 million in 2014/15[2], with 42,209 extractions in England in the latter year[3]. This number decreased to 39,278 by 2015/16, and to 38,385 by 2017/18, with a slight reduction in the proportion of 0-19 year olds experiencing a caries related extraction (0.33% to 0.29%).[3] DGAs put children at unnecessary risk (with a 1:400,000 risk of life threatening problems during the procedure), and in the majority of cases are for treatment of entirely preventable diseases such as dental caries.[2]

There are also concerns that large numbers of children who undergo extractions under a DGA exhibit signs of new carious lesions just six months after initial treatment (range 37-52%).[2] This has led to suggestions that it may be beneficial to extract multiple teeth (including those that may not have been considered carious before a pre-operative DGA assessment) to prevent the need for future DGAs.[4,5] Despite overall improvements in the oral health related quality of life of children following DGAs for extractions [6-19] and positive outcomes for their families, [18,20-26] some aspects of quality of life can be negatively affected,[6] and the experience can be troubling for the child and those close to them.[27,28]

The number of DGA based procedures remains a cause for concern, considering the largely preventable nature of dental diseases. As these episodes have effects on children, their families, and on National Health Service (NHS) costs (as well as other national health systems[29]) and service provision, a better understanding of the trends associated with this is required if action is to be taken. The aim of this research was to conduct a rapid review of current peer reviewed and grey literature on the variation in the use of dental general anaesthetics in children, and the summarise the main themes emerging from this.

Method

A rapid review method was chosen. This approach emphasises the synthesis of evidence in a timely manner and can be used to inform health related policy scenarios.[30,31] Rapid reviews involve the streamlining of more traditional literature searches (such as systematic reviews)[31] and can be more accurately tailored to the needs of the end user.[32] To ensure a timely review, suggested approaches include limiting the number of questions being asked, limiting the scope of questions, searching in

fewer databases, limiting the use of grey literature, de-emphasising hand searching of articles, limiting full text review, and minimal evidence synthesis.[32]

In this review, electronic searches were carried out using MEDLINE via Ovid, covering articles published between 1998 and 2019, to coincide roughly with the period since the publication of the 'Conscious Decision' review of general anaesthetics in primary care in 2000.[1] The search strategy included the following terms: general anaesthesia, general anaesthetic, general anesthesia, general anesthetic, hospital admission, dental, and child. The exact search criteria are summarised in Appendix 1. The inclusion criteria were: studies of children aged 18 and under; studies of DGA trends in children at the health service level; population studies of DGAs in children that assessed associated socio-demographic characteristics; grey literature on the topic of DGAs in children. Results were limited to those written in English, and from more economically developed nations. The exclusion criteria were: studies including adults; studies from less economically developed nations; case studies of single children; studies of medical equipment tested during DGA procedures; and studies focusing on cellular biology or biotechnology. Included articles were exported to a reference manager. Duplicate articles were removed, and the remaining article titles and abstracts were reviewed. Articles not meeting the inclusion criteria were omitted. The main themes within the included papers were identified, with the papers then classified according to these themes. Information relevant to a given theme was then extracted from the paper. The grey literature was assessed through a search of government documents on the topic of DGAs in children, articles published by organisations with a professional interest in DGAs (such as the Faculty of Dental Surgery), as well as through searching the British Society of Paediatric Dentistry (BSPD) clinical effectiveness bulletins.

Results

The searches identified 958 articles, with 23 duplicates identified and removed. This left 935 articles to be reviewed, of which 793 were deemed ineligible for the review, and were excluded, as they did not meet the inclusion criteria. Reference list searching and consultation with experts in the field led to a further 29 articles being identified (including 14 from the grey literature), leading to 171 articles being included in the final review (Figure 1).

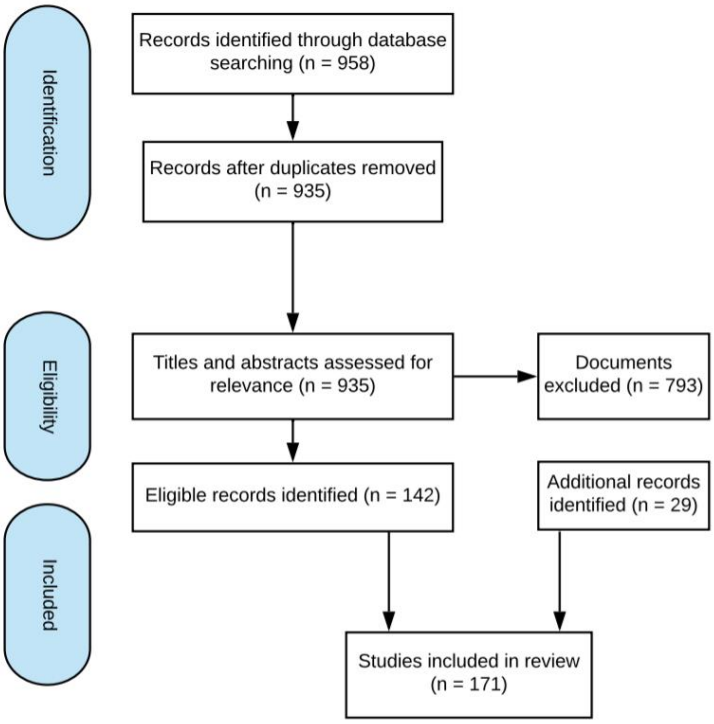

Figure 1 - PRISMA diagram showing literature search process

Summary of the main themes in paediatric dental general anaesthetics

The articles were from countries which tended to be more economically developed, with the majority coming from the UK. Within the literature, the main themes associated with DGAs in children aged 0-18 were: 1) Discussions of DGA variation; 2) trends and patterns at the health service level affecting DGAs, including variations in standards of service provision; 3) socio-demographic and geographical characteristics of children undergoing DGAs. This last category consists of five broad subthemes, these being: age; additional health conditions and learning disabilities; ethnicity and culture; socio-economic and deprivation status; and geographical location. Topics such as diet and water fluoridation were less prominent and are discussed under these five broader subthemes.

1) Discussions of DGA variation

Dental general anaesthetics have become an important topic of discussion outside primary and secondary healthcare settings, particularly in the grey literature.[33-42] In England, data on episodes of children being admitted to hospital for tooth extractions are recorded as part of the Hospital Episode Statistics[3] (HES), and several documents have commented on the limitations of these data in assessing DGA trends [33,36] as well as the wider problems associated with DGAs in children.[34-36] In

addition, plans were described for the creation of a new indicator, which will capture the number of children aged 10 and under admitted for extractions.[33] Numerous organisations have also commented on an upward trend in DGA use (between 2010/11 and 2015/16),[38-41] mainly through reference to the HES data, as well as hospital spending data[43] and the NHS Dental Statistics for England,[44] while also acknowledging the complex and multifactorial nature of DGA use.[36] Suggested contributory factors included deprivation, disease burden, being less likely to access care until symptoms had developed, as well as decreases in specialists who may be able to aid in the prevention of caries.[36,38-41] There are questions regarding the recentness and interpretation of the data used in some reports though.

The British Society of Paediatric Dentistry made the provision of treatment under DGA a priority concern, contributing to national guidelines,[37] as well as outlining four areas of particular concern: escalating numbers of children being referred for DGAs; increased waiting times; inequality of care across regions of the UK; and poor standards of practice, particularly in pre-operative assessments.

2) ***Trends at the health service level, and variations in standards of service provision***

Caries risk (rates of dmft) in particular has shown positive associations with GA prescription.[45] The use of DGAs is usually associated with more severe cases of dental caries, which is unsurprising given that more severe cases would usually be those referred to hospitals and DGA services for treatment.[46] Data from the literature suggests the use of DGAs has increased in some countries in recent years,[47-50] including the mean number of extracted teeth,[5] despite some earlier evidence to the contrary.[51] Following analysis of NHS Digital data,[3] the Faculty of Dental Surgery's interpretation of the data reported a '24% rise in the number of tooth extractions performed on 0-4 year olds in hospitals in England over the last decade' (2006/07-2015/16).[42] It has been hypothesised that this may be due to reduced restorative care being provided for children in the primary sector.[5] This increase also coincides with a time when caries in 5-year-olds has been decreasing.[52] Policy changes (such as introducing capitation as a method for remuneration for treatment of children in the contract, 1990) may also have affected DGA referral numbers.[53]

Factors affecting DGA prevalence described in the literature include: an emphasis on not upsetting children; increases in caries experience in some children; DGAs being a preferred model of care; lower health literacy of parents; parental guilt (that their children have caries, which can affect discussions on the need for DGAs); convenience for parents; and the reluctance of some dentists to treat children due to lack of training and experience.[54] Factors including demand from children and

their families, availability of DGAs, inadequate skills and poorly designed fee scales may also drive this decision,[55] alongside a child's (and their family's) compliance with preventive advice, behaviour in the dental chair, oral health experiences of other family members, and the priority of oral health to the child's family.[47] Changes to remuneration, such as the Units of Dental Activity system in England, may also contribute, through effective measures such as fissure sealants not being supported via UDA payment.[56]

Numerous studies have pointed to the importance of thorough pre-anaesthetic assessments[55,57-63] in making sure that all teeth exhibiting signs of caries are diagnosed, with concern at the lack of pre-operative radiographs.[59-61,64,65] This lack of pre-operative radiographs in some dental settings may, in part, be attributed to children being unable to tolerate intra-oral films. Ineffective communication between referrers and those conducting treatment can also be unhelpful in clarifying the treatment needs of children,[4,66-68] while compliance with referral guidelines has also been shown to vary.[69-71] Referral plans were often altered by the GA providers,[64,72] calling into question the mechanisms and guidance asserting that DGAs should be a last resort,[55] and resulting in changes to the number of extracted teeth.[55,57,59,61,73,74] In some cases this led to fewer children requiring a GA,[55,57,73] while in others a greater number of carious teeth were identified for extraction by specialists.[59,74]

Waiting times for DGA procedures are also problematic,[37,72,75-78] resulting in impacts on sleeping, eating and school performance,[75] and the risk of inappropriate antibiotic prescription.[79,80] Trials of 'sit and wait' DGA options for same day or next day treatment of children with acute pain in order to fill slots that became available have been reported,[76] alongside multiple descriptions of the inefficiencies of DGA hospital lists.[81-83] This has led to inaccurate data collection,[82] particularly when dental procedures are carried out 'piggy-backed' alongside other surgical procedures.[84] Despite these waits, DGAs provided in specialist settings can be beneficial for overall health and wellbeing.[12,85]

Concerns abound regarding the need for repeat DGAs in children undergoing surgery,[2,86-90] with children undergoing DGAs being more likely to develop caries in future,[87,89-95] including those with poor treatment plans.[96] This is particularly true for children with additional health problems.[86,97,98] While the age at which repeat DGAs occur varies,[4,86] a social gradient has been identified regarding DGAs[5], as well as the frequency of repeat DGAs,[99] as these children 'carry the legacy of the disease with them'[75] due to underlying causative factors not being addressed. Rates of repeat DGAs vary regionally within the UK, and are likely to be influenced by combinations of disease incidence, dental service provision, preventive interventions, deprivation, and varying quality in pre-treatment assessment (such as all children being assessed by specialists in paediatric dentistry).[62] Regarding the

latter, those undergoing repeat DGAs were shown to have fewer teeth extracted under initial DGAs than those who underwent a single DGA,[100] adding weight to the argument that more teeth should be extracted at initial DGA appointments.[5] Effective prevention is key to reducing caries, and mitigating the need for repeat DGA.[2]

3) *Socio-demographic and geographical characteristics of children undergoing DGAs*

a) Age

Numerous articles have focused on, or found children aged 5-years and under to be more likely to undergo DGAs.[47,50,55,101-105] Suggested reasons for this include: behaviour problems in the dental chair;[5,47,101,105] (which can affect the ability to provide comprehensive quality care[101]) parents of this group placing less importance on primary teeth, and being more supportive of extractions under DGA;[47,50] reducing physical and emotional stress;[50] and not receiving dental care at any early age in order to prevent disease progression,[47,101,104] sometimes due to dentists being unwilling to see infants and toddlers.[50] Other studies reported no change in age over time,[5] while others saw a decrease in age in children undergoing exodontia under DGA,[96] with some describing differing age profiles between study sites.[106] There are also numerous studies stating that, on average, children aged 5-9 years were more likely to be admitted for DGAs.[41,49,62,69,98,99,107-115] Children aged 5-9 may experience more DGAs due to their primary teeth being less resistant to caries, and their age making treatment under local anaesthetic less likely when compared to older children (10-14 years), where permanent teeth are present.[116] Most studies, with rare exceptions,[113] have found males to be more likely to undergo a DGA.[47,78,101,107,117] This may be due to higher disease prevalence in males,[47,101] as well as suggestions that female children are more aware of their health needs and demand attention from caregivers when in pain.[101] This may also partly be due to male engagement with predominantly female-run health services being less well supported within certain groups.[101]

b) Additional health conditions and learning disabilities

Children with cleft lip and palate[118-120] and those with learning disabilities[104,121] have been found to be more likely to undergo an initial DGA, as well as those with limited interpersonal interactions.[122] Children with special needs may, however, undergo fewer extractions.[123] Such procedures can improve quality of life in children with special needs,[9] although these children face additional barriers in accessing services.[124] While complications can occur in those with additional medical conditions,[125] research from two London based hospitals found that chronically sick children

received a significantly higher level of preventive and restorative care, with a lower mean number of teeth extracted per patient. The authors hypothesised that this may be due to this particular group being under constant medical care and having greater access to specialist dental care, and therefore being referred at an earlier stage of dental diseae.[126] The presence of chronic conditions can also be a predictor of GA use,[127,128] pattern of treatment,[129] and admission after GA.[130]

c) Ethnicity and culture

In more economically developed nations it has been found that children from minority ethnic groups are at greater risk of receiving DGAs, particularly among indigenous groups,[47,50,101,131-138] as well as dental-related hospital admissions where DGAs are not mentioned.[139,140] Similar patterns have been noted for children from non-White ethnicities[107,141] whose uptake increased in line with changing demographic patterns.[142,143] Similarly, across several countries it has been shown that minority groups can also experience higher numbers of extracted teeth.[114] The remoteness of some Aboriginal and indigenous groups also presents a significant barrier to access, as does the socio-economic status of these groups.[101,132] Similar patterns have been found for those with migrant backgrounds in European based studies,[123,144,145] despite some research finding little difference according to ethnicity regarding the ability to complete treatment without a DGA[55] or in the number of decayed teeth extracted.[49,110] Some research indicates variability in the use of DGAs in different populations even in the same country,[146,147] due to a number of factors including access and culturally appropriate service provision rather than simply clinical need.

Cultural factors also play a role in the uptake of DGAs,[101,123,139,148-151] including language barriers,[148] issues with translation of key information,[56,123] poor knowledge of healthcare systems, and differing attitudes towards oral health.[101,123,150] Requirements for DGAs (overnight stays and fasting) can place additional burdens and barriers on families not familiar with hospital settings and protocols.[101] Additionally, oral health related beliefs and practices among parents, [56,99,108,151-154] acceptance and preferences for GAs by parents,[155,156] and a family history of DGA usage[128] have also been shown to be important factors in determining DGA uptake.

d) Socio-economic and deprivation status

Deprivation and socio-economic status also act as key predictors of higher DGA rates, or increased numbers of extracted teeth,[5,49,103,104,113,132,136,148,154,157-164] with little change in this pattern over time,[5] reflecting the link between high caries risk and deprivation in referral areas. Other socio-economic

measures such as parental education (and associated oral health habits),[111,164] occupation,[109] receipt of government benefits,[165] and being part of 'at risk' groups in society[166] have also been linked to children receiving extractions under DGA. Previous research has also pointed to social gradients in DGA uptake[103] and teeth extracted due to caries.[160] Indeed, reductions in caries in the UK may be masking wider inequalities if improvements are concentrated in more advantaged groups.[49]

Non-attendance for continuing care after a DGA is also a more likely issue in deprived areas[161] and among less advantaged groups.[78,167] Residents of deprived areas can face double burdens, including children from the lowest deprivation quintiles, who experience twice as many hospital episodes as those in the least deprived quintile, while also being exposed to greater risk of morbidity and mortality as a result of being more likely to be admitted.[103] Complicated relationships between DGA use (in public and private sectors) and deprivation have been demonstrated, showing that these patterns are not always as clear as they might seem.[159] Private health cover may also influence such patterns.[117,143] Social groups can also differ in the symptoms that require treatment, demonstrating a lack of division along social lines.[158] Although area deprivation has been shown to be strongly associated with higher rates of DGA, rates of DGA have remained high in less deprived areas,[49] as well as in more advantaged groups.[102]

e) Geographical location

Geographical location has been shown to play an important role in the patterning of DGA usage.[2,47,48-50,101,102,104,131,132,148,159,168,169] This has been attributed to differences in providers, commissioners, and dental need and demand across the country,[68,148] with geographical differences in preventive measures noted.[148] Urban-rural differences in DGA has been frequently cited,[49,50,101,161] although not always in the expected direction,[48] while differences between[170] and within urban areas have also been observed.[171] Urban areas are also projected to see large increases in hospital admissions for dental reasons in the future.[171] Some research suggests that geographical differences in DGA use may simply be due to differences in sizes of geographical areas,[102] particularly in larger countries such as Australia and Canada where this becomes an issue for rural living and/or aboriginal groups through access to various health, food, and fluoride related amenities.[50,101,104,131,132] Such areas often experience higher hospitalisation rates, driven by a lack of accessible primary care dental services and rapid caries progression.[50,131,132] Complex relationships between distances to services, deprivation, and public versus private DGA use have also been highlighted.[117,159] Socio-economic factors may be a more important determinant than area of residence,[50] although disentangling this relationship is no easy task.

Discussion

The purpose of this review was to collate and describe the literature on DGAs in children, to understand variations and prominent contributory factors to its uptake. To our knowledge, this is the first rapid review on DGAs which considers such a wide variety of themes.

DGAs are a major concern for policymakers,[33-37] and there has been a growing focus on the reported increase in DGA numbers in recent years in the UK[33-42] and other countries.[50,132,172] Despite the number of contributory factors identified, few solutions (beyond improved prevention at both population and individual levels) have been offered. It is also clear that there are major limitations with the current system for recording DGA activity in the UK,[33,36] although recent strategies have been introduced to address these difficulties.[33] At the health service level, more comprehensive pre-assessments, with appropriately trained clinicians, may help to reduce the risk of repeat DGAs,[55,57-65] and ease the number of repeat DGAs. The need for effective communication between referrers and providers,[4,66-68] and concerns over waiting times for some DGA lists[37,64,75-78] have also been highlighted.

There are also multifaceted socio-demographic issues associated with patterns of DGA use. These have been shown to relate to the age of the child, their ethnicity (and associated cultural factors), their deprivation or socio-economic status, and geographical location. Some individuals may face multiple disadvantages, and therefore face additional barriers and challenges in maintaining good oral health, and avoiding the need for DGAs.[50,103] Contributing factors at the level of individuals, families, society (through inequalities), primary care, and secondary care have also been identified.[173] It is important for all these factors to be considered when evaluating DGA usage, although the complexity of these relationships should also be borne in mind. It is perhaps not surprising that deprivation, ethnicity and geographical location emerged as important correlates for DGAs given their importance as predictors for caries levels among 5-year-old children.[174] Many of the issues highlighted are of a structural nature, affecting both healthcare systems and individuals. The importance of considering and analysing structural components has been demonstrated in previous oral health research.[175]

Both upstream and downstream interventions are needed to improve oral health. Government interventions such as the soft drinks industry levy in the UK ('sugar tax')[176] may have an impact, and population level interventions such as water fluoridation have also been shown to be effective in reducing the number of hospital admissions for tooth extraction. Hospital admissions for caries-related tooth extractions were 59% lower (95% CI 33% to 76%) in areas of England with fluoride of ≥0.7mg/l, compared to areas with no water fluoridation.[177] In addition, local authorities in England

have implemented a range of oral health improvement programmes for children aged 0-5 (both targeted and universal), including oral health training for the wider professional workforce, healthy food and drink policies, supervised tooth brushing programmes, targeted provision of toothbrushes and toothpaste programmes, targeted home visits by health and social care workers, fluoride varnish programmes, community water fluoridation, and peer support workers.[178] Co-ordinated action and system leadership is also important. Public Health England launched the Children's Oral Health Improvement Programme Board with partners across health, education, voluntary and community sectors with the shared ambition that 'every child should grow up free from tooth decay' as part of getting the best start in life. The Board has a cross-organisational action plan, with national-level child oral health programmes such as Starting Well[179] and Dental Check by One[180] forming part of this work. Programmes such as these, as well as Childsmile in Scotland[181] and Designed to Smile in Wales[182] have demonstrated the types of approaches that may be beneficial to reduce DGA rates in the future.

Strengths of the current review include its comprehensive reproducible nature, its wide remit, as well as its timely conduct, allowing the review to be completed in a relatively short space of time. While this allowed for a timely search, it also allowed for a detailed discussion of the variation in DGAs in children, and potential contributory factors at numerous hierarchical levels. There are however a number of limitations to the review, and the approaches taken to ensure its rapidity. The search only included papers from a 20-year period (since 1998), only included articles written in English, and only used one database. One database was used to ensure the rapidity of the review, due to the excellent coverage of medicine, humanities, healthcare, and allied health fields provided by Medline via OVID. While this approach will have gathered most of the relevant literature for this review, there are likely to have been some omissions. The use of the search term 'paediatric' may also have identified additional papers that could have been included. Data extraction by only one reviewer may also have affected the reliability of the search. Additionally, only articles covering more economically developed nations were considered in this review, and therefore studies from less economically developed nations, and the trends specific to these, will also have been omitted. The review has also included trends in DGAs, dental clinics and hospitals, and socio-demographics from a number of national contexts, meaning that the nuances of different systems and approaches may have been lost in the review. For example, each country has numerous ways of constructing measures of deprivation, as well as their own standards within dental clinics and hospitals. Finally, an alternative approach such as a systematic review may have helped to further refine the search criteria, although the heterogeneity of the outcomes involved would likely have prohibited the use of meta-analysis.

Conclusions

This is the first rapid review of current peer reviewed and grey literature on the variation in the use of dental general anaesthetics in children. Important patterns associated with the discussion of DGAs, trends at the health service level, and socio-demographic and geographical features have been found in this review, and demonstrate considerable inequalities between different groups with regard to disease burden, and uptake of DGAs. While this subset of papers identified prevention as the most obvious solution, explicit strategies for its provision, particularly those needed to address overarching structural issues, appear lacking. The numerous variables identified in this review need to be considered together in order to be able to address the complex and multifactorial issues driving increases in DGA provision for children in many countries.

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Appendix 1 – literature search strategies (MEDLINE via Ovid)

Table 1 – First literature search and results

#	Searches	Results
1	General anesth$	37,265
2	Dental	443,056
3	Child$	2,302,792
4	Combine 1, 2 and 3 (using 'and' function)	798
5	Limit to 1998-present	555

6	English only	513

Table 2 – Second literature search and results

#	Searches	Results
1	General anaesth$	15,145
2	Dental	443,056
3	Child$	2,302,792
4	Combine 1, 2 and 3 (using 'and' function)	540
5	Limit to 1998-present	412
6	English only	394

Table 3 – Third literature search and results

#	Searches	Results
1	Hospital admission$	34,733
2	Dental	443,056
3	Child$	2,302,792
4	Combine 1, 2 and 3 (using 'and' function)	63
5	Limit to 1998-present	54
6	English only	51