The DIKW pathway: a route to effective oral health promotion?

James Aukett[1]

Key points

Discusses the DIKW structure as an analytical and developmental tool for communication in the dental surgery.	Suggests that consideration of the DIKW triangle in assessing oral health promotion and other communication processes could be a valid and understandable process.	Discusses the reported effectiveness of oral health advice given in the dental surgery.

Abstract

A large portion of oral health education is carried out by dental care professionals in general dental practice. Awareness that the giving of advice or facts relating to oral disease is unlikely to change behaviour in itself should be a determining factor in the content and delivery of health messages. Recognising the mechanism whereby messages may be translated into actions is fundamental to constructing an oral health plan for patients. The DIKW pathway (data-information-knowledge-wisdom) is an easily understood concept which can be applied alongside, or in place of, more technical behavioural or socio-environmental models to inform the composition of oral health education delivery. This model can be applied also to other areas of communication in the dental setting, including enabling patient decision-making and giving consent. Developed for business information systems and analysts, it suggests a pathway from giving and receiving advice, through to action based on personal contextual meanings and motivations which are perceived as wisdom.

Introduction

True and effective health promotion involves empowerment, capability, control, and self-efficacy in order to achieve sustainable change. A patient has to be enabled to take control of and manage their own oral health effectively in order for oral health promotion (OHP) to have worked.[1,2,3] To achieve the development of personal skills necessary for a patient to manage their own oral health, oral health education (OHE) in general dental practice is built on the provision of data and advice with the intention of improving self-efficacy and self-belief, and ultimately changing lifestyle behaviour. Delivery of advice is emphasised in *Delivering Better Oral Health*,[4] and reflected in recommendations from NICE:[5]

- Give all patients (or their parents or carers) advice during dental examinations

[1]Compliance Consultancy, 16 South Way, Seaford, UK.
Correspondence to: James Aukett
Email: j.aukett@sky.com

- Ensure the advice is tailored to meet individual needs
- Offer brief advice
- Deliver oral health improvement messages in a variety of formats
- Use different media to meet the needs of different groups.

The assumed pathway adopts the knowledge, attitudes, practices model (KAP), based on the premise that increasing a person's knowledge will prompt a behaviour change: the only accepted obstacle to acting rationally is a lack of knowledge; information will change behaviour by overcoming a lack of knowledge.[6]

Limitations and questions about giving information: why don't people do what we tell them?

Assumptions that the acquisition of knowledge supplied by a credible source will automatically lead to a change in behaviour, that people take all the available information, weigh up the costs and benefits of taking each option and pursue the one which maximises benefits to themselves has been countered by findings that

people's decision-making is often irrational rather than being based on straight logic. Understanding of the factors that influence human behaviour has developed significantly in recent years, indicating that traditional approaches based on delivering information and sending messages are insufficient on their own to affect people's health behaviour and choices.[7,8]

A multitudinous plethora of health behavioural, social learning, self-regulation and innovation models and theories from social and psychological sciences are applied to construct routes leading to beneficial behaviour change. Consumer information processing models suggest that people are deterred by complex, conflicting or extensive information processing, and select which bits of information to assimilate.[9] Choices are determined by personal hierarchical goals or motivation,[10,11,12] perceptions, and by related choices made in the past. The many influencing factors external to the actual message include the source of the message, the medium used to convey the message, positivity or negativity in framing messages,[13] and the variable effects of the use of fear as a motivating force.[14,15]

Behaviours and behaviour change are not determined alone by one source of data given. They are more habitual and governed by alternative, often conflicting information or cues in the immediate environment, reacted to both consciously and subconsciously. Information in the form of messages given by dental care practitioners cannot be seen in isolation. Account needs to be taken of existing information and the multiple other sources of new information feeding into the process. In our social media-driven society, patients are increasingly looking to the internet to gather information on their signs and symptoms, on treatments available and offered, and on opinions of others, and are using this alongside traditional sources of information.[16,17,18] Social cognitive theory[19] suggests that decisions are made and behaviours are formed from the observation of others' behaviour and the rewards or punishments resulting from them. The 'mindspace' policy of the UK Government suggests that the likelihood of a decision to change behaviour is affected by nine major environmental and psychosocial influences including the messenger, incentives, norms, defaults, salience, priming, affect, commitment and ego.[20]

However, many of these arguments are dependent upon assumptions relating to the use made of data and other stimuli, as well as how the influence of single and multiple cognitive and affective inputs determine decision-making. There are limitations to the amount of information that people can acquire, use and remember. The absorption and processing of information cannot be assumed to be a straightforward or logical activity. The DIKW pathway illustrates this.

The nature of knowledge and the DIKW hierarchy

'Where is the life we have lost in living? Where is the wisdom we have lost in knowledge? Where is the knowledge we lost in information?' T. S. Eliot *The Rock* (1934).

The DIKW hierarchy, also referred to as the DIKW pyramid, is used in knowledge management, information science, information management systems in industry, commerce, and businesses, and ICT (Information and Communication Technology), to provide an explanation of how data in the form of signals and messages are processed to become wisdom which informs actions and decisions. 'Information' is a term which is freely used

synonymously with other terms such as advice, data, facts, evidence, understanding, learning, knowledge and wisdom. However, they are not interchangeable concepts. The distinction between forms of input has been presented by the DIKW hierarchy.[21,22,23,24] Understanding the differences and how you get from one to another is fundamental to the process of communication in health education, in gaining understanding and agreement of interventions, and in obtaining patient consent for intervention.

Common sense would tell us that the basic presentation to a patient of data or raw facts about a disease process is unlikely to elicit a reaction unless it is presented in a way, or processed by the patient in a way, to provide information to inform positively a decision-making process relating to behaviour. The DIKW process suggests that information is also insufficient; the process must continue to produce this unique concept of wisdom. The nature and essence of wisdom, as a unique and separate entity necessary for informed and productive decision-making, becomes apparent from the many diverse definitions and descriptions of the term. The reference content of the human mind used in mental transformation is classified into categories by the DIKW model. Despite, or because of, the multiplicity of authors defining terms, the concepts do not have clear indisputable definitions, but themes can be extracted.

Data

Symbols, discrete objective facts that basically exist in any form, or anything that can be transformed in a mental process. Comparable to entries into a spreadsheet, data are valueless and only become of use when human involvement takes place.

Information

Data endowed with relevance and purpose,[25] which become meaningful because they have been given structure through human interaction and relationships with other data elements, or with the immediate environment. Information has value.

Knowledge

The collection and application of data and information representing a pattern to make it useful, and therefore of value, by providing a level of predictability about what is and what might be. For information to become knowledge, comparison with other

situations, consideration of consequences or implications of decisions and actions, connections with other knowledge, and consideration of how significant others regard this information, is required. Knowledge arises from complex social, goal-driven, contextual, and culturally-bound process, driven by having desires and curiosity.[26] The formula is: information + experience = knowledge.[27] This is reflected by Davenport and Prusak who suggest that knowledge is:

'A fluid mix of framed experience, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluating and incorporating new experiences and information'.[28]

Understanding

An intermediate term, 'understanding', is suggested.[29] This stage emphasises the difference between memorising and learning, between simply knowing something, and using cognitive and analytical processes to take new knowledge and combine it with old knowledge to synthesise new knowledge. This stage is similar to some of the human processes required to move from information to knowledge and then on to wisdom.

Wisdom

Evaluated understanding of fundamental principles, derived from the synthesis of elements of knowledge and information, extrapolation, and from applying consciousness and human values (morals, ethics, heart and soul). Wisdom is said to be able to distinguish right from wrong, and good from bad.

This continuum suggests that the 'data' given has to be somehow transformed into 'information' by a series of processes including contextualisation, categorisation, clustering, condensation, calculation and correction to make it useful in informing decision-making.[21] The change then into 'knowledge' involves having, developing, or being given understanding, insight, intuition and experience in order to be able to show relevance. Relating new information to a current problem or activity of significance or importance at that time, weighing advantages and disadvantages, recognising obstacles and capabilities, and being able to apply new knowledge, completes the wisdom chain. Progression along the DIKW continuum increases the influence of the input. The concept of developing raw data input into an

initiating factor or cue to behaviour change can be shown to underlie the theory of many behaviour change and communication models. For advice-based dentist/patient decision-making, the task is to provide data in a way that it is, or can become, information, knowledge, understanding and wisdom, and to understand how this in turn will lead to initiating a want or an intention to change behaviour, which will then be interpreted into a new behaviour pattern. This model has been criticised,[29,30] but consideration of the general principles is an awareness raising experience for practitioners of health promotion.

Incorporating information processing into oral health promotion

Although this model was developed for handling information in business and other areas, a link exists for translating the principles into health promotion. Bloom's taxonomy, used in educational theory and practice,[31] effectively models a similar transition from teaching input to productive wisdom (Table 1). Criticised, modified, and updated,[32] this set of three models relating to cognitive, affective and psychomotor elements uses a translation from knowledge to physical action using similar terminology which makes the parallel and comparison clear.

Consider the following:

- Bacteria live in the mouth
- Some bacteria are potentially harmful
- If undisturbed, bacteria grow and organise into a biofilm or plaque
- Biofilms produce toxins and enzymes
- Some bacteria process sugar to produce acids
- Some toxins can destroy connective tissue
- Tobacco smoke contains chemicals which can cause malignant change
- Tobacco smoke contains toxins which can destroy connective tissue

- Connective tissue binds gums to other tissues
- Some toxins can induce inflammation and bleeding
- Some acids can destroy tooth enamel
- Loss of connective tissue can lead to loss of teeth
- Loss of tooth enamel can lead to pain and sepsis
- Loss of tooth enamel can ultimately lead to loss of teeth
- Gum inflammation can lead to bad breath
- Tooth loss is unsightly
- Tooth loss means you cannot enjoy food as well
- Tooth loss can affect the way you speak
- Tooth loss is not socially acceptable
- Replacing lost or damaged teeth is costly and unpleasant
- Repairing or replacing lost teeth is not permanent
- Tooth loss can be prevented
- Toothbrushing disrupts the biofilm
- Fluoride in toothpaste lowers the critical pH of enamel
- Mouthwashes can check the influence of the biofilm
- Your diet contains sugar
- Your teeth have biofilm coatings
- Your gums bleed
- Fissures on your teeth are stained
- Some of your teeth are loose.

Each statement might be regarded as an individual message or piece of datum, but only when it becomes related to other pieces do they coalesce into information. Given individually, each is an irrelevant fact; given in any order, information can only be extracted as other statements appear and are linked. Adopting them to inform a current personal situation creates knowledge. Using powers of interpretation and experience to understand how they can be used to satisfy a felt need creates wisdom.

Research showing that people are already relatively well-informed about oral health behaviours, opportunities, and actions, suggests there is little value in concentrating solely on raising awareness and knowledge.[33] In 2004, the Department of Health identified that a problem with health messages was not a lack of information, but that the information given was inconsistent and out of step with the way people lived their lives.[34] In management practice, organisational success and failure depends on knowing which of information, advice, data, facts, evidence, understanding, learning, knowledge or wisdom are required, which are available, and what can and can't be done with each.[28] In terms of DIKW, the data is being presented in a way that fails to facilitate a complete transposition into information, knowledge and wisdom. Presenting data in a way which makes it more likely to be transformed into action is an essential part of a behaviour change process.

Effective dental communication depends on the sequential presentation of relevant data in an appropriate form in order for the recipient to be able to recognise the data as being relevant to them in the form of personal risk and vulnerability (information), being able to use information beneficially (knowledge), and being able to calculate the benefits of feasible change, or the consequences to personal health/wellbeing from inaction, in order to decide how to react (wisdom). Wisdom includes a commitment to change.[35] A commitment to change is a prerequisite of turning knowledge into wisdom and action, and depends on recognising that knowledge exists both structurally and contextually.

Oral health promotion effectiveness

Anecdotally, in dentistry the same messages are repeated to patients constantly.[36] It is common practice for patients to be referred regularly to a hygienist or dental therapist because their oral hygiene, periodontal condition, or caries incidence persistently fails to improve. The inconclusive evidence surrounding the clinical effectiveness of regular scale and polish interventions suggests that the practice is flawed.[37,38,39,40] There are many alleged sources of the idea that 'there is nothing that a dental clinician can do which will overcome that which the patient will not do'. That may be true of clinical intrusions, but the opportunity to introduce oral health

Term	Explanation
Table 1 Bloom's taxonomy terms[31,32]	
Knowledge	Remembering, recognising, facts, concepts
Comprehending	Understanding, meaning, translation, interpolation
Applying	Manipulating, modifying, using
Analysing	Breaking down, component parts, contrasting and comparing, differentiating, inferring
Synthesising	Structure, patterns
Evaluating	Judgements, quality, validity
Creating	Combining, synthesising, generating

promotion, via appropriately structured and incremental interventions, should change 'that which the patient will not do'. While there is growing evidence that appropriately structured and targeted health promotion can yield positive results, the effectiveness of surgery-based OHP has been questioned repeatedly,[41,42,43,44,45,46] summarised by findings reported by the National Institute for Health and Care Excellence (NICE):[47]

- No evidence about the cost-effectiveness of behaviour change interventions
- Interventions fail to link satisfactorily to health outcomes; no clear outcome measures
- Evaluations do not relate to outcome measures
- No evidence on the comparative effect on health inequalities, especially cultural difference
- Little evidence on links between knowledge, attitudes and behaviour
- Little reliable data on long-term effects of behaviour change interventions.

Rather than addressing behavioural, lifestyle and socio-environmental determinants of health to achieve self-efficacy, repeated professional intervention perpetuates reliance and dependence on the dental profession, contrary to the aim of health promotion and arguments that such dependence is counterproductive.[48,49]

Failure to achieve positive results in health promotion has been shown to be due to programmes where evidence-based health promotion is not effectively incorporated.[33,50,51,52,53] Such a failure has been demonstrated in materials used in oral health education.[54] Truly successful health promotion is dependent upon parallel and linked strategies running in a coordinated plan to influence the behavioural and lifestyle determinants of health. Acknowledging that there are conditions and requirements for health behaviour change which are outside of the control or influence of a dentist-patient relationship, or even of the dental profession, is an important condition for constructing an oral health plan. Clinically-based OHP in surgery is based on the single area of developing personal skills which alone, while able to have an effect and a significant contribution, is insufficient to bring about the fundamental changes required to improve oral health. Guiding patients to be aware of such factors is necessary for individuals to develop the wisdom to act accordingly.

Conclusion

The purpose of communication in the dental surgery is to give advice and send messages with the ultimate intention of protecting or improving oral health, defined in terms of disease, physical function and psychosocial purpose. Therefore, the responsibility of the clinician or educator does not end with the giving of advice to patients about their oral health. It is recognised that simply telling people facts about disease and health, about operative procedures and opportunities, and about risks and benefits, is insufficient. Processes for improving the effectiveness of messages are based on an assumed predictability of social and behavioural models and considerations, but there is no single model which has proven predictable or appropriate in all cases of health behaviour change. It is the role of dental communication to ensure that the patient not only understands the messages but is able to recognise their relevance and be able to apply them.

Health promotion advocacy requires the inspiring of patients to explore and consider their health needs both normatively and personally defined. The skill to combine these elements has to be developed. It is a professional obligation to put the patient's interests first; it is an ethical responsibility to guide the patient along the most appropriate path. Applying the DIKW pathway to oral health messages provides an alternative model for informing the shaping, formatting, deciding the content, and delivering items of data (Table 2). Planning communication processes with the intention of turning data into wisdom and beneficial action is an alternative construct to help to focus where health advice and patient decision-making might be made more effective and ethically fulfilling. The endpoint is better, individually-focused, and more responsive and considerate patient care.

This paper is presented as a basic introduction and overview of the application of DIKW theory to oral health processes. The model should be developed in line with advances and developments in associated

Table 2 Framework for interpreting the DIKW pathway into roles for (oral) health education

Format	Definition/changes required to move to next level	Possible roles of health promoter
Data	Meaningless facts, symbols	Present facts about disease and health
	Contextualise, gather and connect, shape and structure. Structured data with relevance becoming meaningful to person	Personalise data to show relevance. Common risk approach
Information		Relate to personal circumstance and situation. Advocacy
	Comparing, considering, combining and connecting, giving meaning, internalising. A useful pattern or structure of information having implication for achieving goals	Connect to show cause and effect related to personalise susceptibility, vulnerability, motivation and life goals
Knowledge		Show how new knowledge can combine with old knowledge to achieve personal goals or wants
	Added insight, understanding value of knowledge, being able to use knowledge for personal benefit. Synthesis of personal motivation and realisation and understanding of benefits or disadvantages. Knowing what is 'right'	Exploring basis of attitudes and perceptions, increasing efficacy and self-belief in capability
Wisdom		Planning achievable goals and stages; identifying barriers as moveable and opportunities as achievable
	Activating intention, reflecting, realising capability, identifying opportunity Behaviour change Sustained lifestyle improvement	Enablement, mediation
Action		Reinforce motivation; enhance perception of benefits; set new goals. (In a wider role: strengthen community action, creating supportive environments)

fields. Already a revised cognitive system of knowledge, which claims to reconstitute knowledge management, adds new dimensions at each end of the pyramid: 'existence', a layer beneath and a precursor to data, at the bottom; and 'enlightenment', a state of mind surpassing wisdom at the top.[55] The field of patient oral health-related behaviour continues to evolve.

The achievement of a personally-derived state of wisdom would be a factor in helping to avoid the repetitive cycle of patients receiving the same messages continually. The ultimate goal of empowering patients to define, recognise and manage their own oral health efficiently through their own wisdom could become more realisable, and the ultimate goal of empowering patients to define, recognise and manage their own oral health efficiently could be closer. Whereas it is easy to be wise after the event, effective health promotion should be making patients wise to avoid the event.

References

1. Scheerman J F, van Loveren C, van Meijel B *et al.* Psychosocial correlates of oral hygiene behaviour in people aged 9 to 19 - a systemic review with meat-analysis. *Community Dent Oral Epidemiol* 2016; **44:** 331–341.
2. World Health Organisation. Jakarta Declaration on Leading Health Promotion into the 21st Century. 1997. Available at http://www.who.int/healthpromotion/conferences/previous/jakarta/declaration/en/ (accessed May 2019).
3. World Health Organisation. Health Promotion. A discussion document on the concept and principles. 1984. Available at https://apps.who.int/iris/handle/10665/107835 (accessed May 2019).
4. Public Health England. Delivering better oral health: an evidence-based toolkit for prevention. 2017. Available at https://www.gov.uk/government/publications/delivering-better-oral-health-an-evidence-based-toolkit-for-prevention (accessed May 2019).
5. National Institute for Health and Care Excellence. Oral and dental health overview. 2016. Available at https://pathways.nice.org.uk/pathways/oral-and-dental-health#content=view-info-category%3Aview-about-menu (accessed May 2019).
6. Rav-Marather K, Wan T T H, Marather S. A systematic review of the KAP-O framework for diabetes education and research. *Med Res Arch* 2016; **3:** 1.
7. World Health Organisation, Regional Office for the Eastern Mediterranean. Health education: theoretical concepts, effective strategies and core competencies: a foundation document to guide capacity development of health educators. 2012. Available at https://apps.who.int/iris/bitstream/handle/10665/119953/EMRPUB_2012_EN_1362.pdf?sequence=1&isAllowed=y (accessed May 2019).
8. Anonymous. Interview: Say no more... An insight into the Behavioural Insights Team. *Br Dent J* 2017; **223:** 560–562.
9. The Communication Initiative Network. Consumer Information Processing Model. 2003. Available at http://www.comminit.com/global/content/consumer-information-processing-model (accessed May 2019).
10. Bettman J R. *An Information Processing Theory of Consumer Choice.* Boston, MA: Addison Wesley, 1979.
11. Maslow A H. A theory of human motivation. *Psychological Review* 1943; **50:** 370–396.
12. Herzberg F. *Work and the Nature of Man.* Cleveland, OH: World Publishing Company, 1966.
13. Gergen K J, Gergen M M. *Social Psychology.* 2nd ed. New York, NY: Springer, 1986.
14. Janis I L, Feshbach S. Effects of fear-arousing communications. *J Abnorm Psychol* 1953; **48:** 78–92.
15. Rochon J. An Evaluation of the Seat Belt Education Campaign. 1977.
16. Coleman O, Walker T W M, Kerai A, van der Valk R, Thomas S J. #JawSurgery: Analysis of social media use in orthognathic surgery patients. *Br Dent J* 2018; **224:** 635–638.
17. Hamm M P, Chisholm A, Shulhan J *et al.* Social media use by health care professionals and trainees: a scoping review. *Acad Med* 2013; **88:** 1376–1383.
18. Keller B, Labrique A, Jain K M, Pekosz A, Levine O. Mind the gap: social media engagement by public health researchers. *J Med Internet Res* 2014; **16:** e8.
19. Bandura A. Social cognitive theory of mass communication. *In* Bryant J, Oliver M B (eds) *Media Effects: Advances in Theory and Research.* 3rd ed. pp 94–124. New York, NY: Routledge, 2009.
20. Dolan P, Hallsworth M, Halpern D, King D, Vlaev I. Mindspace: Influencing behaviour through public policy. 2010. Available at https://www.behaviouralinsights.co.uk/publications/mindspace/ (accessed May 2019).
21. Hey J. The Data, Information, Knowledge, Wisdom Chain: The Metaphorical link. 2004. Available at http://www.dataschemata.com/uploads/7/4/8/7/7487334/dikwchain.pdf (accessed May 2019).
22. Ackoff R L. From Data to Wisdom. *J Appl Syst Anal* 1989; **15:** 3–9.
23. Sharma N. The Origin of Data Information Knowledge Wisdom (DIKW) Hierarchy. 2008. Available at https://www.researchgate.net/profile/Nikhil_Sharma15/publication/292335202_The_Origin_of_Data_Information_Knowledge_Wisdom_DIKW_Hierarchy/links/56ad5af408ae28588c5fc36f/The-Origin-of-Data-Information-Knowledge-Wisdom-DIKW-Hierarchy.pdf?origin=publication_detail (accessed June 2019)
24. Snowden D J. Complex Acts of Knowing: Paradox and Descriptive Self-Awareness. *J Knowl Manag* 2002; **6:** 100–111.
25. Drucker P F, Collins J, Kotler P *et al. The Five Most Important Questions You Will Ever Ask About Your Organization.* San Francisco, CA: Jossey-Bass, 2008.
26. Weinberger D. The Problem with the Data-Information-Knowledge-Wisdom Hierarchy. *Harvard Business Review* (Cambridge, MA) 2010 February 2.
27. Thierauf R J. *Knowledge Management Systems for Business.* Santa Barbara, CA: Greenwood Publishing Group, 1999.
28. Davenport T H, Prusak L. *Working Knowledge: How Organizations Manage What They Know.* Brighton, MA: Harvard Business Press, 1998.
29. Bellinger G, Castro D, Mills A. Data, Information, Knowledge, and Wisdom. Available at http://www.systems-thinking.org/dikw/dikw.htm (accessed May 2019).
30. Fricker M. The knowledge pyramid: a critique of the DIKW hierarchy. *J Inf Sci* 2008; **35:** 131–142.
31. Bloom B S (ed). *Taxonomy of Educational Objectives, Handbook 1: The Cognitive Domain.* 2nd ed. Boston, MA: Addison-Wesley Longman, 1956.
32. Anderson L W, Krathwohl D R, Airasian P W *et al. A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives.* 2nd ed. New York, NY: Pearson, 2000.
33. Asimakopoulou K, Newton J T. The contributions of behaviour science towards dental public health: a new paradigm. *Community Dent Oral Epidemiol* 2015; **43:** 2–8.
34. Department of Health. *Choosing Health: Making healthy choices easier.* 2004.
35. Gamble P R, Blackwell J. *Knowledge Management: A State of the Art Guide.* London: Kogan Page, 2001.
36. Bader J. Insufficient evidence to understand the effect of routine scale and polishing. *Evid Based Dent* 2005; **6:** 5–6.
37. Beirne P, Worthington H V, Clarkson J E. Routine scale and polish for periodontal health in adults. *Cochrane Database Syst Rev* 2007; CD004625.
38. Fox C. Evidence summary: does 'routine' scaling have any beneficial effects, or is it a waste of time? *Br Dent J* 2010; **208:** 477–478.
39. Worthington H V, Clarkson J E, Bryan G, Beirne P V. Routine scale and polish for periodontal health in adults. *Cochrane Database Syst Rev* 2013; CD004625.
40. Watt R G, Marinho V C. Does oral hygiene promotion improve oral hygiene and gingival health? *Periodontol 2000* 2005; **37:** 35–47.
41. Brown L F. Research in dental health education and health promotion: a review of the literature. *Health Educ Q* 1994; **21:** 83–102.
42. Kay E J, Locker D. A systematic review of the effectiveness of health promotion aimed at promoting oral health. *Community Dent Health* 1998; **15:** 132–144.
43. Kay E J, Locker D. Is dental health education effective? A systemic review of current evidence. *Community Dent Oral Epidemiol* 1996; **24:** 231–235.
44. Schou L, Locker D. *Oral Health: a review of the effectiveness of health education and health promotion.* Amsterdam: Dutch Centre for Health Promotion and Health Education, 1994.
45. Sprod A J, Anderson R, Treasure E T. *Effective oral health promotion: literature review.* Cardiff: Dental Public Health Unit, Health Promotion Wales, 1996.
46. Young Y, Clarkson J, VDP Trials Group. The Effectiveness of Enhanced Oral Health Advice and Instruction upon Patient Oral Hygiene, Knowledge, and Self-Reported Behaviour: A Randomised Controlled Trial. 2015. Available at http://www.sdpbrn.org.uk/wp-content/uploads/2015/03/OHI_Effectiveness_Summary-2.pdf (accessed May 2019).
47. National Institute for Health and Care Excellence. Behaviour change at population, community and individual levels. 2007. Available at https://www.ncsct.co.uk/usr/pub/guidance-on-behaviour-change-at-population.pdf (accessed May 2019).
48. Illich I. *Medical Nemesis.* London: Calder and Boyars, 1975.
49. Mckeown T. *The Role of Medicine: Dream, Mirage or Nemesis?* London: Nuffield Provincial Hospitals Trust, 1976.
50. Angus K, Cairns G, Purves R, Bryce S, MacDonald L, Gordon R. *Systematic literature review to examine the evidence for the effectiveness of interventions that use theories and models of behaviour change: towards the prevention and control of communicable diseases.* Stockholm: ECDC, 2013. Available at https://ecdc.europa.eu/sites/portal/files/media/en/publications/Publications/health-communication-behaviour-change-literature-review.pdf (accessed May 2019).
51. World Health Organisation. 7th Global Conference on Health Promotion. 2009. Available at http://www.who.int/healthpromotion/conferences/7gchp/en/ (accessed May 2019).
52. World Health Organisation. *Global school health initiatives: achieving health and education outcomes.* 2017. Available at: https://www.who.int/healthpromotion/publications/global-school-health-initiatives-report-meeting-2015/en/ (accessed August 2018).
53. Kay E, Vascott D, Hocking A, Nield H, Dorr C, Barrett H. A review of approaches for dental practice teams for promoting oral health. *Community Dent Oral Epidemiol* 2016; **44:** 313–330.
54. Gray-Burrows K A, Owen J, Day P F, Learning from good practice: a review of current oral health promotion materials for parents of young children. *Br Dent J* 2017; **222:** 937–943.
55. Faucher J B, Everette A M, Lawson R. Reconstituting knowledge management. *J Knowl Manag* 2008; **12:** 3–16.