Introduction

Personalising menopausal healthcare with tailored information and shared decision making between the health professional and woman is the ideal. This should begin before the menopause transition. This review will explore the evolving opportunity that the Internet affords in enabling this process.

Over the past decade, the management of woman's healthcare has changed from the alleviation of menopausal symptoms to include the management of other life-changing medical issues falling under the aegis of post-reproductive health; A life-course approach[1] aimed at both maximising health and minimising, if not preventing, negative sequelae in this third stage of a woman's life, provides an important framework for care. This framework is recognised by the Royal College of Obstetricians and Gynaecologists as a standard in which to understand and mitigate against the long-term effects of earlier biological, behavioural and social exposures. A life-course approach in women's health also acknowledges gender-specific medicine.

Gender-specific medicine is the study of how diseases differ between men and women in terms of prevention, clinical signs, therapeutic approach, prognosis, psychological and social impact – it is a neglected dimension of medicine.[2] Gender differences in susceptibility to complex diseases; e.g. asthma, diabetes and depression, come under the umbrella of epigenetics.[3] Epigenetics is the study of factors which control gene expression other than the genetic code itself, and epigenetic markers have been shown to be passed on to children and grandchildren[4]

challenging the paradigm that disease caused by lifestyle can have no effect on offspring. The Barker hypothesis[5] was a forerunner to epigenetics and proposed programming *in utero* and in infancy as a mechanism for later poor health. Links are well established between reduced birth weight and increased risk of coronary heart disease, diabetes, hypertension, and stroke in adulthood. The possibilities of understanding these complex relationships are being explored in the emerging fields of systems biology[6] and Big Data analytics[7]. Mitigating against this "toxic" information and other future diseases that have epigenetic origins fits within a life-course framework, not least maximising post reproductive health.[8] The Internet is expected to be increasingly utilised as a tool for pathological and biological testing. Direct to consumer genetic testing is already available and the market is expected to grow and to date, negative effects on consumers or health benefits have yet to be observed. [9]

The future of medicine is increasingly being mediated through preventative, participatory, personalised, and predictive (P4) modes. It is, by necessity, changing from a reactive model to a preventative patient-centric one with information and communication technologies (ICTs) playing an increasing role.[10]

There is also a move from solely a biomedical model of healthcare to a biopsychosocial model.[10] which recognises that in addition to the biomedical model, psychological, social, environmental and cultural factors all can impact on human functioning in the context of disease and illness. The western biomedical paradigm targeted principally at treating infectious diseases has been effective in delivering health care, but this model is not positioned to tackle the complex societal challenges or solve the current problems facing health care and delivery caused by

ageing populations with increased incidence of long term/chronic conditions and globalisation. The biopsychosocial model is a call to change the way of understanding the patient and to expand the domain of medical knowledge to address the needs of each patient.

Within this latter model is recognition that “one size does not fit all” and that evidence based medicine from randomised controlled trials does not always easily translate into clinical practice.[11] One of the reasons preventing this transition of practice from trials to bedside is the patient’s psychosocial circumstances. It is therefore incumbent on health professionals to recognise this and tailor treatment and management plans accordingly. Providing healthcare in an increasingly patient-centred way allows the achievement of preferable health outcomes. The health professional-patient relationship therefore is increasingly a shared model of decision making in the preferred outcomes process.[12] This can be thought of as personalisation of healthcare in which a dialogue takes the best medical evidence and information available and creates a management plan that fits with the patient’s lifestyle and preferences.[13] This personalisation may be a compromise on best medical evidence in order to accommodate the patient’s wishes. This preferred health outcome differs from possible (might it happen), plausible (could it happen) and probable (how likely is it to happen) outcomes. The preferred model emphasises the woman’s co-participation in exploring all the evidence and options for the management of a condition and the implications thereof. This evidence and options are increasingly being influenced by ICTs utilising the World Wide Web and the Internet (Table 1).[14]

The World Wide Web

The World Wide Web (The Web) is a compilation of documents and other web resources, linked by hyperlinks and Uniform Resource Locators or URLs. The Web went live in March 1989 and is already the largest human information construct in history transforming societies everywhere. The Internet, a system of computer networks, which the Web uses as the conduit to access information, has been around since the 1960s. The Web has evolved from Web 1.0, focused on simple non-interactive documents, to Web 2.0, utilising the tools of interactivity and social space. Health related technology has followed suit, i.e. Health 1.0, Health 2.0, Medicine 2.0, however, no consensus regarding their definition exists.[15] It is without question that the Web is dynamic and evolving, with interactivity at its core. Web 3.0, knowledge and reasoning systems also known as the semantic web and web of linked data, is at the beginning of its evolution and aims to allow computers to understand and respond to the meaning of complex human requests through linking of multiple disparate databases.

Menopause and the Web

In a review published 10 years ago in the Journal of the British Menopause Society – 'The Internet and the menopause consultation: menopause management in the third millennium'[16] seven ways were suggested in which the Internet could be used in the menopause consultation (Table 2).

From a global perspective, all these have occurred to a greater or lesser extent in the management of the menopause. Table 3 shows a comparison of traditional and

new ways of delivering healthcare using the Internet and provides advantages and disadvantages of new possibilities.

www.menopause matters.co.uk as an exemplar of menopause management

The website www.menopausematters.co.uk is patient-tailored, physician-led. The website went live in 2002 and has steadily grown in popularity, reflecting both the increasing interest in web-based health information and the increased access and computer literacy of the public. The site aims to educate women and health professionals and to empower and enable women to take a more active part in the management of their menopause. Their discussion with their health professional then increasingly becomes a shared process by incorporating the first 5 points in Table 2. The website was created in consultation with end-users through feedback questionnaires. Through online surveys, the website aims to obtain “snapshots” of Internet literate women’s views on all aspects of their menopause experiences and provide feedback to them and their health professionals.

www.menopausematters.co.uk surveys have consistently demonstrated that women are reluctant to seek help for reduced libido,[17] vaginal atrophy,[18] dyspareunia[18] and urinary incontinence[19] despite adverse effects on health and wellbeing. Furthermore, a large number of women who obtained information from health professionals and the Internet felt that they did not have enough information to make informed decisions regarding the use of HRT and alternative therapies. Additionally, health professionals frequently fail to explore these areas during consultations despite proven treatments being available. Preliminary evidence has also suggested the power of the media through digital online storytelling to empower women to seek

help for vaginal atrophy. [20] The power of the media was shown in a survey[21] which suggested that younger women were more susceptible to negative media reports concerning HRT than older women. www.menopausematters.co.uk continues to strive to be accessible to women and health professionals promoting evidence based practice and recommendation and encouraging them to be proactive in their care.

The next step in menopause advice – tailoring the information to the woman

While www.menopausematters.co.uk allows health professionals and women to select expertly prepared information (Web1.0) or interact with one another (Web 2.0) via the forum it is limited with respect to personalisation. The main aims of www.managemymenopause.co.uk are to provide more personalised healthcare advice that empowers women to make informed choices about symptom management and risk factor modification underpinned by expertly prepared information. www.managemymenopause.co.uk utilises a patient questionnaire and three risk prediction tools to generate a tailored advice document that provides risk advice and information on lifestyle modification and pharmacological interventions - both hormonal and non-hormonal. As users have directly participated in the generation of the advice document, it is hoped they will be motivated to use the information provided to facilitate a discussion with a healthcare provider about symptom control and to make the necessary lifestyle modifications that will help prevent future disease. This UK website went live in November 2015 to coincide with the release of the first UK NICE menopause guideline[22] highlighting individualised care. The website will “remember” a woman and can therefore tailor the information to the woman as she ages or as the information underpinning the management of menopause changes.

Tailoring information Postmenopause

The benefits of seeking online health information and participatory Internet use have generally focused on young or middle aged women. The postmenopausal age group is increasingly technologically literate. These developments are particularly timely as older women have an increased risk of chronic illnesses. For this group access to interactive health information on the Web holds particular promise.[23] Older women, and particularly those with mobility limitations impacting visits to physicians, can pose particular challenges. Availability of web-based communication with health care providers will thus increasingly offer health benefits.[24]

The opportunities for healthcare and its delivery in the Internet age can be formulated as in Figure 1, underpinned by the disciplines of Health Web Science and Medicine 2.0.

Health Web Science & Medicine 2.0

Health Web science is a sub-discipline of Web Science[25, 26, 27] that complements and overlaps with disciplines under the aegis of Medicine 2.0. In short, Health Web Science studies the role and impact of the Web on health and well-being and conversely the impact of health related uses of the design of the Web structure and evolution that explicitly includes an alliance with nonmedical stakeholders. Medicine 2.0 or next generation medicine enabled by emerging technologies (Eysenbach, 2014, introductory talk to Medicine 2.0 Malaga), on the other hand, arguably emphasises anything that uses the Internet as a conduit to deliver health care. As

the tools of Web 3.0 evolve it will become possible to interrogate different sources of data to achieve more robust answers to individualised health care questions.

Health Web Observatory

The Web Science Trust hosted by the University of Southampton is a charitable body which supports the global development of Web Science.[28] The Trust .introduced the concept of a Web Observatory[29] as an integrated collection of data sources and data analysis tools that enable observation and experimentation for Web study.[30] The Web Science Trust has further positioned a web observatory to bridge the gap between Big data and the rapidly growing web of Broad data.[31] This distinction between Big data and Broad data is important. Analysis and conclusions from Big data on a subject may come from one source only, whereas analysis and conclusions from Broad data on a subject come from many data sources. This enables triangulation and increasing the veracity of the conclusions. A Health Web Observatory therefore is a system that links to and gathers health and usage data on the Web (Big data and Broad data) in order to answer questions about the web, the users of the Web, and the way that each affects each other within the domain of health related uses.

Internet health provision

Health Web Science, Medicine 2.0 and Health Web Observatories have potential to be major catalysts in the evolution of Internet health. Internet health is a broad term that encompasses telemedicine, e-health (the transfer of health resources and

healthcare by electronic means) and mobile health (m-health):- the use of wireless technology to deliver health services and information using mobile communication devices such as tablet computers, smart phones and other monitoring devices.[32] Monitoring devices that are beyond the scope of this article are becoming more ubiquitous i.e. both external (including environmental) and internal with self-monitoring a growing part of P4 medicine.

Virtual clinics are becoming increasingly utilised within the NHS. These are in lieu of face to face contact and can take a number of forms.[33] A novel evolution of virtual clinics using digital technology to deliver and facilitate patient engagement with health provision is NHS Grampian's No Delays[34.] This concept uses video on demand to provide personalised patient postcards. No Delays aims to transform outpatient services by helping people to take responsibility for their own care, provide care as close to home as possible and reduce the need for attendance at hospital clinics or unscheduled admission to hospital. The No Delays platform is not a static website but a dynamic resource that allows clinicians to work interactively with patients to improve understanding of their condition and/or treatment. No Delays allows healthcare teams to digitise elements of their local care pathway by creating interactive packages of digital content that can be personalised by healthcare professionals and prescribed to patients according to their needs.

Economics of Internet health provision

Implementing the UK's Delivering Assissted Living Lifestyles at Scale (dallas) programme and the lessons learned from it provide a useful framework in which to implement digital healthcare tools and services at scale.[35] In a review of cost utility

and cost effectiveness of Internet health provision[32] the authors concluded that due to methodological flaws economic evaluations are limited due to disparate estimation methods, lack of randomised controlled trials, lack of long term evaluation studies, small sample sizes and absence of quality data and appropriate measures. Similar conclusions were reached in a Norwegian review[36] which observed that despite a limited number of large-scale services and sparse evidence e-health is cost-effective, interest in e-health continues to grow. This continuous interest might be explained by the promise of e-health to solve some of the pressing problems in health care.

Future

Using the tools of Medicine 3.0, the disciplines of Medicine 2.0 and Health Web Science, and the technology underpinning Web Observatories, the ambition is to provide a framework to build an integrated online social network for women's health. This network will be populated by women, health professionals and health related sites that are capable of being linked to each other for further study. Thus, these data sources will be able to be interrogated to personalise healthcare questions, and then through dialogue and traditional medicine, plan a preferable health outcome. Health professionals in primary and secondary care will provide increasingly personalised care supporting patients to develop the knowledge and skills to become active partners in their own healthcare using the information from these evolving decision aids.[37] New tools and metrics will need to be developed to assess the impact of these technologies on health outcomes.

Conclusion

The recently published NICE guidelines have supported individualized care.[38] The Royal College of Obstetricians and Gynaecologists (RCOG) life-course framework encourages predictive, preventative, participatory and personalization of healthcare. Using this framework, management of the post-reproductive epoch starts well before the menopause transition. Shared decision making towards a woman's preferred health outcome can be a compromise between best medical evidence and a woman's choice. ICTs have an increasing role to play in healthcare. Health Web Observatories informed by the disciplines of Medicine 2.0 and Health Web Science have potential to deliver individualised medicine of the future. More research is needed to evolve the tools to assess the impact of ICT on healthcare and its delivery. Health professionals will increasingly support patients to be active partners in their own care. The cost effectiveness of these interventions also need to be addressed

www.menopausematters.co.uk will continue to survey women's experience of the menopause and continue to address how to improve both women and health professional knowledge of the menopause.

www.managemymenopause.co.uk will continue to personalise healthcare and refine its ability to be specific for that individual.

In the Journal of the British Menopause Society 2005 paper we concluded that the transfer of health resources and health care by electronic means (ehealth) has the potential to be a union made in heaven between man and machine. We still believe that.

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The authors comprise a multidisciplinary, international team reflecting the collaboration required to deliver healthcare in the 21st century and in particular post-reproductive healthcare utilising the power of the Internet. The team therefore represents computer scientists, gynaecologists with an interest in menopause, a designer with a psychology background and a medical sociologist specialising in aging. The team epitomises the collaboration required to make Health Web Science and Medicine 2.0 possible. The authors have previously published in the areas of menopause, Health Web Science and Medicine 2.0.

Box 1 What users do online[11]

66% look for information about a specific disease or medical problem
54% ask doctor new question or get a second opinion from another
36% affected their decision whether or not to visit the doctor
58% say the advice has improved the way they take care of themselves
55% say access has improved the way they get health information
24% female users look for information about pregnancy and childbirth
70% say information has influenced their decision how to treat an illness
27% have monitored a health parameter online
4% have posted their experience with a drug or treatment
24% consulted online reviews of particular drugs or treatments
44% look for information about doctors or other health professionals
15% have consulted online rankings or reviews of hospitals or other medical facilities

Box 2. Potential role of the Internet in facilitating the menopausal consultation.

1 as a resource for additional information or support before or after a visit to a health professional;

2 as a resource during a visit to health professional;

3 for online support groups and forums;

4 as an intervention;

5 as a resource for consultation between specialist and generalist;

6 for online consultation

7 for prescribing.

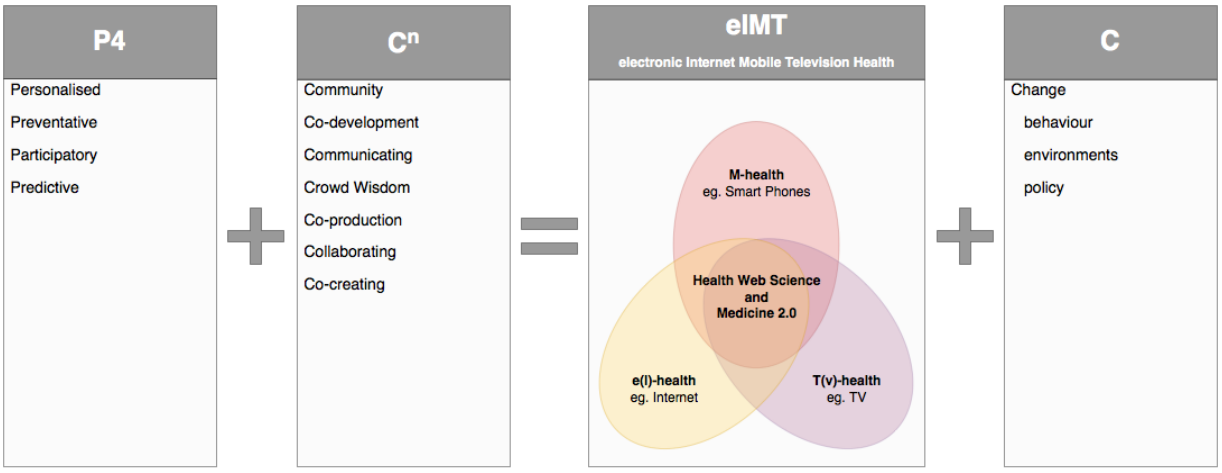
Table 1. Comparison of traditional and new ways of delivering healthcare using the Internet.

Adapted from *Medical Profiling and online medicine: the ethics of personalised healthcare in a consumer age*. Nuffield Council on Bioethics 2010. Nuffield Press, Oxfordshire

Healthcare activity	Traditional method	New possibilities	Advantages	Disadvantages
Seeking health information	Health professional Newspapers Family Friends	Online search engines Kitemarked Websites &"Internet prescribing" Online communities Forums/Facebook User generated content You Tube, Blogs	Convenience 24/7 information Empowerment Expert patient	Incorrect information Misinterpretation Worried well Threat to health professional and therapeutic relationship
Support	Health Professional Family Friends	Online communities Forums, Facebook, Messaging, Texting User generated content You Tube, Blogs	Convenience Wisdom of the crowd Cost	Incorrect information Misinterpretation Worried well Threat to health professional and therapeutic relationship
Public Health	Health Professional TV Radio Paper advertising	Twitter Facebook Websites SMS texting	Speed Cost	Digital Divide between the 'haves' and 'have-nots'
Therapeutic Interventions		Web sites Apps and App prescribing Facebook	Being at home Convenience Cost	Not been evaluated – may do harm
Patient records	Hospital GP records Maternity hand held record	Electronic health record Emergency Patient Summary	Storage Available "anywhere" Data mining	Cost Incompatibility of systems Data entry burden

				Security
Obtaining medication	Over the counter Medical prescribing	Web sites	Being at home 24/7 availability Convenience	Inappropriate Not genuine product Inappropriate advice Risk of Antibiotic resistance Threat to health professional and therapeutic relationship
Diagnosis, monitoring and management		Apps Teleheath Telemedicine Remote consultations, diagnosis monitoring and management prevention	Being at home Earlier transfer of care from hospital to home	Potentially intrusive "surveillance of lifestyle"
Incentivisation	Health campaigns Targeted groups for awards	Social gaming	Viral uptake Individualised	Digital Divide

Figure 1. Formulating Healthcare



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