Smart dental practice: capitalising on smart mobile technology

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IN BRIEF

- Describes ways in which smart mobile technology can improve dental practice efficiency and patient experience.
- Highlights updated information on mobile technology and practice management.
- Suggests processes to develop and implement mobile apps.

To keep pace with consumer adoption of smart mobile devices, such as smartphones and tablets, and the applications ('apps') developed for these devices, dental professionals should consider how this technology could be used to simultaneously improve both patient service experiences and dental practice management. Using U-Commerce as a theoretical lens, this article discusses the potential value of smart mobile technology to the dental practice context, with a particular focus on the unique and customisable capabilities of apps. To take full advantage of this technology, a process is outlined for identifying and designing bespoke dental apps that takes into account the unique advantages of these devices. Dental practices, with increasing financial and competitive pressures, may improve the efficiency and profitability of operations and better manage patients, employees and stakeholders by integrating smart mobile technology.

INTRODUCTION

The IT revolution began in dental practice in the early 1980s with the introduction of computerisation of patient records, appointment scheduling and billing.[1] The last 30 years have seen rapid growth in dental IT with the advent of digital radiography, digital intraoral cameras and flat-screen chair-side monitor technology. Practitioners and administrators, in addition to streamlining scheduling and records management functions, are now able to share technical information concerning conditions and treatments with their patients. Technology has given practitioners the ability to visually and interactively show patients the precise state of their dental health, and illustrate what future treatments will be achievable.

In recent years, the role of IT in the dental practice – not just the IT itself – has shifted even more dramatically, with the standardisation and widespread availability of networked, high-speed wireless and cellular connectivity. Traditionally, all IT functions in the dental practice (indeed, in any organisation) were owned and controlled by management. However, responsibility for many IT-enabled administrative functions of the practice is now being shifted from management to patient. Since many patients now often own smart mobile devices with high-speed Internet connectivity and the ability to easily run customised software applications, responsibility for basic administrative functions such as scheduling, billing and communications can be, and is being, shifted from the practice to the patient.[2]

Particularly in the United Kingdom, with cuts to NHS budgets,[3,4] this responsibility shift is becoming more pronounced and may even be considered necessary for the financial self-sustainability of dental practices, under increasing pressure to become less dependent on state funding. Not all practitioners will embrace or introduce new technology initially, as the learning curve and capital outlay for IT system implementation, alongside operational process adjustment, may be seen as a deterrent. However, innovative dental practices capitalising on smart mobile technology will be able to realise efficiencies in labour resource allocation as well as improvements in patient experience and satisfaction, leading to increases in both productivity and profitability.

Smart mobile devices, such as smartphones and tablets, are computerised personal digital assistants with integrated high-speed Internet connectivity.[5] Where just a few years ago the mobile phone was simply a device for making telephone calls, today's smart mobile devices have evolved to become extremely powerful computing devices with significant and unique capabilities. These devices are capable of running unique software applications (referred to as 'apps') that enable users to complete a remarkable array of complex tasks simply and efficiently.

Organisations in an assortment of industries, both product- and service-based, have realised the potential of connected smart mobile devices and apps to change the way business operates and interacts with customers, employees and other stakeholders. Dental and other practitioners are in the midst of a 'paradigm shift' in healthcare,[6] where patients are willing, able and often determined to assume responsibility for management of their personal health, records and transactions, enabled in large part by information technologies and networked connectivity.[7,8] In addition to the cost savings and operational efficiencies of 'outsourcing' IT to the customer, research shows that customers involved in and given responsibility for some aspects of the operational processes of a service encounter are actually more satisfied with their experiences, as they feel more ownership of and control over their interactions (for example, Bendapudi and Leone[9]).

This paper discusses methods of integrating smart mobile devices into dental practice IT systems in order to change how the dental practice team interacts with patients. The paper highlights the fundamental differences between smart mobile devices and personal computers relevant to the dental practice context. Next, the authors apply the U-Commerce

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framework to help understand the potential use of dental smart mobile device apps, and use illustrative micro-cases to exemplify how apps are currently being used in dental practices. Lastly, the authors prescribe a process to identify and develop customised apps aligned with the dental practice's strategy to further enhance productivity, profitability and patient engagement.

SMART MOBILE DEVICES: MORE THAN THE INTERNET AND EMAILS

Smart mobile devices are handheld, portable, personal computers that use and combine the power of microprocessor-driven computing technology with Internet connectivity. As such, the authors use the term 'smart mobile device' to refer to both smartphones and tablets. Sales of smart mobile devices have increased exponentially in recent years. For the first time, smartphones outsold feature (that is, non-smart) mobile phones in 2013, up to 53.6% of global handset sales from 42.3% in 2012.[10] Tablets, additionally, are forecast to outsell desktop PCs and laptops by the end of 2015.[11]

Smart mobile devices have three defining characteristic abilities: to run software apps of the user's choice at the user's discretion, to store data, and to access the Internet via cellular or WiFi networks. Additionally, smartphones have the capability to make and receive calls and SMS messages. Both smartphones and tablets often include accelerometer and gyroscope functions that provide a strong functional difference (position and motion) from portable PCs or laptops. Additional common features of smart mobile devices include camera functionality and supplementary short-range networking technologies such as Bluetooth, infrared or near field communication.

When considering the applicability of smart mobile devices to dentistry, any integration or use of smart mobile devices in a dental practice must be part of an overall information systems strategy. Thus, in the following section the authors discuss and apply the U-Commerce framework in order to better understand and exploit the unique capabilities of smart mobile devices within the dental practice context.

U-COMMERCE AND THE DENTAL PRACTICE

Noting the increased prevalence of networks of all kinds, and in all aspects of personal and business life, Watson *et al.*[12,13] proposed 'U-Commerce' as a theoretical framework to help understand the effects of these networks on society and business. U-Commerce is defined as 'the use of ubiquitous networks to support personalised and uninterrupted

Table 1 U-Commerce dimensions and related micro-cases

U-Commerce dimension	Definition	Micro-case
Ubiquity	Access to information unconstrained by time and space	Cavity Free 3D, Dental Aid
Uniqueness	Knowing precisely the characteristics and location of a person or entity	UK Dentists, Tooth First Aid
Unison	Information consistency	QSI Dental Web
Universality	Overcomes the friction of information systems' incompatibilities	PerioVoice

communications and transactions between a firm and its various stakeholders to provide a level of value over, above and beyond traditional commerce'.[13] While the more familiar 'E-Commerce' represents an Internet-enabled shift in retailing, economic exchange and distribution methods, U-Commerce represents all forms of value exchange between organisations and individuals enabled by networks and technology. Beyond, but including, monetary exchange in the purchase and sale of goods, value exchange can include the exchange of other resources like time and information.

U-Commerce operates within four dimensions – ubiquity, uniqueness, unison and universality – that define characteristics of value exchange.[13] These four dimensions are described below, and illustrated using micro-case studies of dental practice apps. The apps described in the micro-cases might also suitably fit under another dimension, however the authors contend that there will be considerable overlap between the four dimensions and have simply sought examples that fit the illustration of points as discretely as possible.

Dental app case studies were pulled from the Apple iTunes app store, an online repository of software applications for Apple smart mobile devices. In the search for appropriate dental app case studies, two observations were made: first, there were significant numbers of apps developed specifically for the dental profession; however, the authors were unable to accurately count this number due to the lumping of these apps into the larger 'Medical' category (consisting of approximately 20,000 medical apps) and there is no further search functionality in Apple's app store. Second, the majority of the dental apps the authors researched did not take advantage of smart mobile devices unique capabilities; rather, they simply transferred activities that could be conducted on the desktop computer to the mobile platform (for example, dental health tips, treatment handbooks, checklists of procedures, stock illustrations and videos, etc). However, a small number of dental practice apps designed specifically to exploit the capabilities of the smart mobile devices were

found. Not surprisingly, the authors did find that these 'higher-quality' customised functionality apps were asking a premium payment, whereas the 'lesser-quality' apps were often free. Table 1 briefly describes the four characteristics of U-commerce and dental related micro-cases.

UBIQUITY

The ubiquity dimension of the U-Commerce framework identifies access to information, unimpeded by time and space.[14] Individuals desire information in various situations and at various times and network technology such as GSM, 3G, LTE and WiFi enable ubiquity in smart mobile devices and their apps. Ubiquity, in a dental practice context, might refer to the ability of patients to obtain information about or demonstrations of preventative care or clinical procedures, regardless of the location or time at which they choose to access such information.

Micro-cases: Cavity Free 3D and Dental Aid

Cavity Free 3D offers users illustrated step-by-step instructions for proper care of teeth, gums and orthodontic braces. Cavity Free 3D[15] is designed to be an educational tool that practitioners can recommend to their patients to ensure that quality of care and maintenance continues outside of the practice. Dental Aid is an app that helps explain treatments to patients by outlining many different procedures in nine categories ranging from examination to dental implantology. Within the searchable app, each procedure is linked to step-by-step high-definition images and illustrations.[16]

UNIQUENESS

Uniqueness, the second dimension of the U-Commerce framework, describes the understanding of precise, individual, user-specific characteristics.[14] User-specific characteristics may be geographic location, scheduled appointments, behavioural data, or personal preferences. Smart mobile devices are equipped with location technology (GPS), and integrate apps to collect
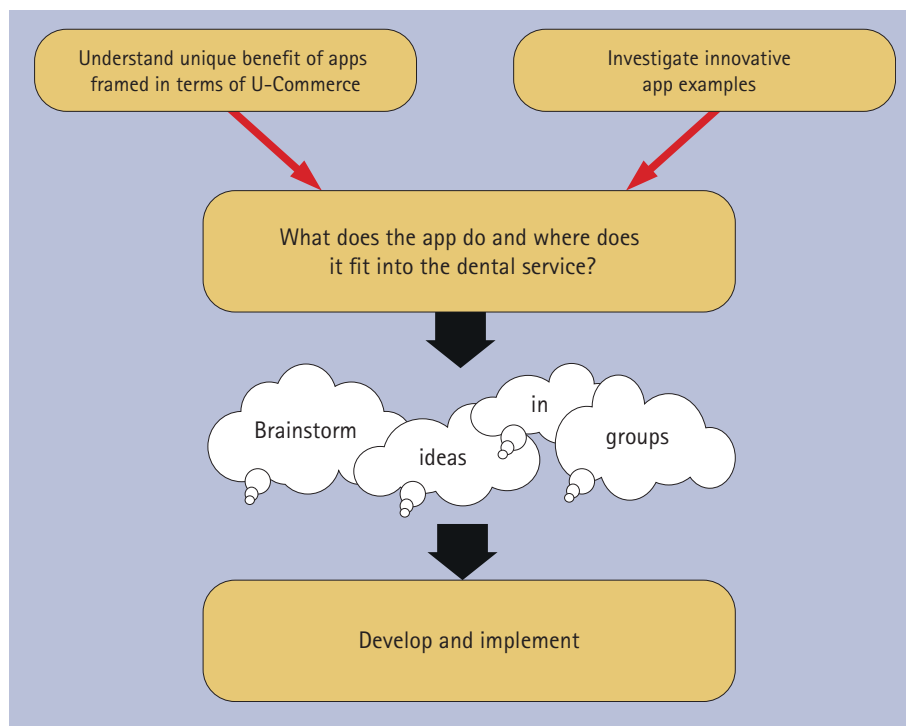
Fig. 1 Smart mobile device app development process

scheduling and many other individualised data that reflect characteristics of the owner of the device. As such, information can easily be customised to the current context and particular needs of the individual smart device user.

Micro-cases: UK Dentists and Tooth First Aid

UK Dentists is an inexpensive application (69p or $0.99) that searches the Internet for NHS dental offices within a geographic area around the mobile user.[17] The app then lists available dentists. When the user selects a particular dental practice, further options to map directions to or place a telephone call to the office are presented, as well as the ability to send the dentist's information to one of their own personal contacts. Also similarly, a popular American app called Tooth First Aid, uses the smart mobile device's GPS and compass functionality. Tooth First Aid first uses the GPS and compass functions to allow the user to search common dental concerns and ailments (for example, chipped teeth, bleeding gums or tooth sensitivity), and prescribes interim advice for immediate self-care at the same time and then links and directs the user via Google maps to the closest available practitioner offices via Google maps.

UNISON

The unison dimension considers consistency and synchronicity of a user's information across, between and regardless of access points.[14] Individuals want to be sure that information accessed from their smartphone,

tablet, personal computer or Internet (for example, documents, data, contact lists, emails, calendar appointments) is the same. Thus, dental practice apps need to offer information that is consistent and synchronised with other information sources.

Micro-case: QSI Dental Web

QSI Dental Web is a full-scale electronic practice management software system[18] that includes appointment scheduling, searchable medical records, billing and financial management, digital prescription management and support for digital radiography and imagery. Notably distinct from other locally hosted practice management systems, QSI Dental Web is a cloud-based software programme: all software applications and data are stored, accessed and managed securely online via the Internet. This Software as a Service (SaaS) model provides applications and data storage to practitioners without the need for costly local hardware and network infrastructure, and allows full secure access to the practice's database over local area, WiFi or cellular networks from any authorised computer or smart mobile device. QSI Dental Web allows the dental team to access patient information from any location at any time, manage schedules remotely, send files or prescriptions to partner practitioners, and so forth.

UNIVERSALITY

The final dimension of the U-Commerce framework, universality, describes the ease of moving information from one functional system to another, in an effort to overcome

data exchange conflicts between systems, by consolidating and integrating functionality into more powerful computer systems.[14] Smart mobile devices integrate many functions into a single, portable device. Smartphones, unlike their feature phone predecessors, serve not only as a mobile telephone, but also as an Internet browser, calendar, calculator, music player, video player, camera, global positioning system, and even shopping mall. All of these functions, unlike those on a computer, are constantly on, connected, and physically with the user. A dental patient could, for example, use the voice recognition function to speak a search query into the map function, find a dental practice nearby using the map's integrated Internet search capabilities and then click on the displayed phone number to call the practice and book an appointment, which can then be input into the calendar.

Micro-case: PerioVoice

While the apps illustrated in the cases above indeed highlight the multifunctional and integrated capabilities of smart mobile devices, PerioVoice takes a less common approach to maximising the potential of smart mobile devices. PerioVoice is a voice recognition system for the dental team to expedite charting. Following on-screen prompts, the practitioner speaks 'chart information' and PerioVoice will input data into its integrated charting software.[19] Charts can then be emailed, printed wirelessly, or exported to either on-board or networked EPM software such as QSI Dental Web, thus fully integrating several capabilities of the iPhone.

The above dental app micro-cases illustrate the potential for progressive and efficient dental practice management inherent in each of the four U-Commerce dimensions, for both practitioners and patients, underscored and magnified by the dynamic and unique capabilities of smart mobile devices.

CAPITALISING ON SMART MOBILE TECHNOLOGY

Pressures are mounting from all sides for dentists around the world to simultaneously improve both profitability and customer service. These pressures are particularly notable in the United Kingdom, where state funding for dental care is being minimised and dental practices must become financially self-sustainable businesses. In light of this, dental practice teams may be well advised to integrate existing smart mobile device apps, such as the case study examples described above, into the dental practice to increase efficiencies of time, money, labour and other resources for both management and

patients. At the same time, as with any IT system, there are limitations to an off-the-shelf software solution, and there may be additional potential behind designing customised, bespoke apps to better fit the overall brand and strategic goals of the practice. The authors outline this second option by examining the structured smart mobile application development process (Fig. 1).

To begin, the dental team must concurrently consider two things: (1) the unique benefits and abilities of smart mobile device apps, and (2) the pros and cons of currently available offerings. On one hand, practice management must understand the unique benefits of apps in comparison to other similar technologies (for example, locally networked desktop or laptop computers) in terms of the U-Commerce framework, and as related to the specific needs and current operations of the dental practice. On the other hand, practice management is advised to identify opportunities for app development through vicarious learning[20] – investigating benefits, drawbacks and innovations of currently available apps, as well as competitive operations management practices, to identify market opportunities. The most effective and valuable apps are ubiquitous, unique to the individual, universal, and in unison, for the benefit of practitioners and patients.

Next, the dental team needs to identify exactly what a proprietary app should and could do, and where and how it might fit into the dental service process. The authors recommend a customer-centric process model, such as the customer resource life cycle model,[21] although there are a number of alternatives in the information systems, marketing and strategy literatures. Originating in strategic information systems literature, the influential customer resource life cycle model provides a structured, consumer perspective on the decision-making process in terms of acquiring, using, and retiring a product or service. In dental terms, this process outlines how patients choose dental practices, experience its services and either continue to be a loyal patient or switch to a competitive dental practice in the future. Understanding this patient process is key to designing an effective app that both improves patients' experiences with the dental service and saves valuable and scarce dental practice resources for patient acquisition, treatment, management and retention.

After the patient process is understood, the dental team needs to co-operate creativity and brainstorm ideas for apps that both target problematic or costly areas identified in the previous steps and fit strategically with the financial, operational and service goals of the dental practice. Brainstorming in groups, popularised by Osborn,[22] has shown

to double creative output. Depending on the nature of the app needed by the practice to meet these goals, it may be imperative to consider patient information privacy and security issues. After these concerns and goals have been considered, brainstormed, and narrowed, the app can then be slated for development and implementation. If a customer-facing app is designed to capitalise on the outsourcing of management functions to the patient, listing and recommending the app on the practice's website and listing on various app stores is advisable. Depending on both development costs and value to consumer accessibility, it may also be advisable to charge a fee for the app, which generates additional revenue for the practice.

In short, the decision to design a bespoke app is one that a dental team must not take lightly, because of resource constraints. As with any IT system upgrade, the pros and cons of off-the-shelf *vs* proprietary applications must be considered, and the most viable strategic option pursued for the long-term sustainability and profitability of the practice. When considering app purchase or development, understanding the unique features of smart mobile devices, as well as having examples of apps that leverage U-Commerce dimensions is a sound starting point. Through understanding patients' experiences, dental teams can develop or acquire apps that target specific needs and wants of patients. The authors contend that smart mobile device apps, bespoke and otherwise, are important tools to add to the dental patient experience and increase the likelihood of retaining patients while saving limited practice resources.

STRATEGIC SMART MOBILE TECHNOLOGY IN DENTAL PRACTICE

In the modern age of increasing privatisation of the dental practice, compounded by cost pressures from the government, dental practices that incorporate advances in information technology will potentially see vast competitive benefits in terms of both practice operations (cutting costs) and customer service (increasing revenues). Cloud-based software and technology offers dentistry many benefits such as eliminating the need for costly local servers and reductions in capital software acquisition expenses, while enabling collegial collaboration and access to electronic health records, securely, from any device with a browser. The authors have outlined how smart mobile technology, quite literally in the patients' hands, can be leveraged in the dental practice context to improve patient service, increase operational efficiency, and save financial and other resources, thus improving and the practice's bottom line and sustainability.

Many patients will likely already own smart mobile devices and will either expect, or be pleasantly surprised to learn, that their dental practice is embracing this technology in the effort to improve the patient experience. The authors have illustrated the many benefits of smart mobile technology through the U-Commerce framework, and also described a process for identifying and designing bespoke apps that fulfil the specific strategic needs of a dental practice.

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