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Minimal Data Set for Remote Clinical Consultations in Restorative Dentistry - An Exploratory Case Study

ABSTRACT

In the UK, general dental practitioners (GDPs) in primary care are supported in the patient care decision-making-process by specialist consultants in secondary care centres. The consultation, undertaken as an in-person consultation between the patient and the consultant, consists of a comprehensive clinical assessment: The outcome is conveyed to the patient, GDP and other stakeholders as appropriate. Tele-dentistry has the potential to provide an alternative approach through a Remote Clinical Consultation (RCC).

To make the encounter as efficient as possible it is helpful to identify data that is essential for the safe and effective conduct of the process. The aims of this exploratory case study are (i) to discriminate between data sets of specialist clinical consultations in endodontics, periodontics and prosthodontics; and (ii) to investigate the opinions of secondary care providers for in-person and RCCs. An online questionnaire was administered to secondary care specialty clinicians in restorative dentistry in the UK (Specialist consultants and senior trainee grades). Results: It is feasible to identify a generic minimum data set for specific consultation processes specifics vary between specialties and experience of the clinician. Views of the consultation process, in-person vs remote, varied between consultants and trainee grades.

INTRODUCTION

The combination of super-fast secure internet connectivity and accessible high-definition audio-visual technology make the possibility of three-way remote clinical consultations between patient, primary care dentist and secondary-care specialist a technological possibility. The potential advantages of a RCC are more effective patient-centred group decision-making, improved community access to oral health care, interprofessional collaboration to address rural oral health disparities,[1-4] reduction in patient travel and associated CO_2 footprint,[5] accelerated patient-care pathways through managed clinical networks[6] and potential improved cost-effectiveness.

The combination of fast and secure internet connectivity and high-specification audio-visual communication technologies make the possibility of telemedicine a reality for conducting specialist remote clinical consultations in dentistry. Teledentistry has been described as either, the use of telecommunication technology to transmit data (form text to images and videos) to people physically separated, for the purpose of clinical care or the remote provision of dental care.[7,8]

Keywords

Consultation
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Remote Clinical Consultations

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Jampani *et al*. describes the delivery of tele-dentistry as being either real-time or a 'store-and-forward model' (information is sent to repository where it is kept and sent at a later time to the final destination).[9] Both models are based on the availability of fast and secure internet connectivity and would need to know what data to deliver or share in a timely manner for an effective consultation. This requirement is not trivial as the transfer might have a cost consideration, and a missing piece of information might influence the effectiveness and safety of the clinical decision making and the subsequent treatment strategy. It is clear, that a real-time remote consultation requires a very fast and secure broadband connection to transfer patient-sensitive and high definition data in real-time, in a manner analogous to an 'in-person' face-to-face encounter.

The availability of the internet, high-speed data transfer, secure internet protocols, ubiquitous and portable computing solutions, low cost technology, mobile phone applications, VoIP applications and immersive virtual reality provide the opportunity to investigate digitally-supported solutions for health care delivery with Teledentistry.[10,11] The use and transfer of digital data is already widespread in dentistry; for patient management and patient records;[12-14]in a clinical setting with intraoral cameras and scanners to support remote diagnosis;[15-18] clinical decision support systems;[19-21] patient education[22-24] and in dental laboratories with advanced manufacturing technology.[25]

Patient-centred care is a key driver for the development of tele-dentistry and an example of this, is its use to improve community access to oral health care and eliminate disparities between rural and urban communities.[1-3] Mills *et al*. (2014) stipulated that the patient should expect the clinician to be clinically effective, have their safety as a priority and ensure that they have a good experience during their visit. This has been termed patient-centeredness. The measurement of these three areas: clinical effectiveness, safety and patient experience is not evidence based and is an area where more work is required.[26] Remote clinical consultations (RCCs) are an application of teledentistry with the potential to positively impact patient-centered oral health care. RCCs shift the decision-making-process from a one-to-one scenario (clinician-patient, dentist-patient, clinician-dentist) to group decision making. This model is in line with the need for increased patient involvement in the NHS treatments. The UK Government response to the consultation 'Liberating the NHS: no decision about me, without me' considers the practical implementation of the proposal and suggests that providing accurate and accessible information for people to make informed decisions about their care is a fundamental right; and that a culture change to enable patient involvement to become routine in the NHS.[27]

Tele-dentistry holds the potential for establishing true group-decision making between the three key stakeholders; patient, dentist and specialist consultant. Studies on the factors required for effective group-decision-making have shown that doing so using remote connectivity can be at least as effective as face-to-face in person. Strasser *et al*. (1992) highlight that a group of three works best when the individual contribution of each person in the group is clear, while groups which had a less structured approach are not as effective as they do not fully utilise the available information.[28] Dougall and Friske (2008) suggested that good communication facilitates the building of trust, helping reduce patient anxiety and enhancing patient satisfaction and compliance.[29]

In the UK, the current specialist consultation process between a patient under the care of a General Dental Practitioner (GDP) and a specialist consultant in secondary care is a multi-step process, with communication between only two of the parties at any one time. It involves a referral letter from dentist to consultant, a consultation between specialist and patient and this is followed by a return report-letter from consultant to the dentist with findings and a suggested plan of action. A peer review study undertaken by Joshi (2003) of the written communication that occurs between GDPs and the consultant identified several communication problems, which could result in miscommunications and clinical mistakes.[30] Involvement of all parties in a group-decision has the potential for reducing this risk in the consultation process.

A collaborative system using tele-communication through the use of telemedicine, dental image tools, sharing electronic patient records and video-conference help to establish a cooperative diagnosis, treatment planning and professional mentoring in the field of dentistry.[31-32] An alternative view point highlights that whilst there is emerging support for the efficacy of tele-dentistry, the concept lacks conclusive evidence in terms of effectiveness and cost-effectiveness to make evidence-based implementation decisions.[33]

Having considered the relative merits of RCCs using tele-dentistry, it is important to establish how this can be provided in a pragmatic manner. In addition to the technological challenges, there is a need to understand the aspects of a specialist consultation that are essential for this process to work, the perceived limitations of the current system amongst the stakeholders, and the perceived barriers for the uptake of a RCC. This paper investigates the digital data needs required to undertake a clinical remote consultation in secondary care in the UK. In particular, we aim to:

(i) Determine if it is feasible and valid to consider a minimum data set required to conduct a remote digital consultation in the various restorative dentistry specialties.

(ii) Investigate the opinion of the specialist consultants and senior (final year) trainees on the advantages and disadvantages of the current system and a potential tele-dentistry solution.

The hypotheses for this study are

H1: There is a difference in the items of data required according to specialty.

H2: There is data requirement difference according to years of experience, where the more experienced specialist would require less data.

If the hypotheses are true, it may not be possible to determine the minimal data set required for a clinical consultation required to be provided to carry out the consultation as per the stated 'baseline standard'.

Essential to ensuring that the RCC process is practical, efficient and safe (not inferior to the standard 'in-person' consultation), it is necessary to understand what are the key components of a 'consultation process' that are considered essential to deliver the 'baseline standard'. For the purpose of this project, we have established a 'baseline standard' for a specialist clinical consultation in restorative dentistry with the following characteristics:

- Allow for a full and unimpeded dialogue between the patient (or representative) and the specialist consultant.
- Enables the conduct of a full and appropriate clinical assessment, to include a comprehensive history, clinical examination and required special investigations.
- Enables the establishment of appropriate and accurate diagnoses (including differential) and a prognosis for every diagnosis reached.
- Enables the establishment of a patient-centred and pragmatic treatment options and/or a treatment strategy for the management of the referred condition and any additional diagnoses.
- Enables the preparation and submission of a report to be returned to the patient and the referring dentist following the consultation, that includes the findings of the consultation and the outcomes as above.

METHOD

The methodology is designed to pursue the aims through the following objectives:

(i) To identify all the data capture requirements that are necessary to undertake a specialist consultation in restorative dentistry.

(ii) To determine the 'minimum required data' for the RCC process.

(iii) To obtain the views and opinions of the surveyed specialist hospital consultants and senior trainee grades (Specialty Registrars - StRs) regarding the current consultation referral process and remote alternatives.

Fifty-three individuals were recruited to participate in an anonymous survey questionnaire. This was done through an email-shot to a customised list of consultants of the Association of Consultants and Specialists in Restorative Dentistry (ACCSRD-UK) and in person at the annual joint conference of the ACCSRD and Specialist Registrars in Restorative Dentistry (SRRDG). Completed surveys were received from 35 specialist consultants and 18 senior grades (4th & 5th year) Specialist Registrars in Restorative Dentistry (StRs).

The questionnaire was created by the research team based on the input from six consultants in restorative dentistry from the Charles Clifford Dental Hospital, Sheffield, UK. These consultants were interviewed, with open-ended questions to compile a list of all the possible data that a specialist might need to conduct a consultation. A beta-version of the questionnaire was then tested as a pilot on the same group of consultants and based on the outcome, this was modified accordingly.

The final questionnaire consisted of five sections: (i) Participant's demographic information including their specialty, current position, years of experience; (ii) six types of information that the volunteers considered as essential to record the history of the condition; (iii) A list of all the possible types of data (18 items) considered to be essential for a diagnosis, prognosis and treatment strategy, subdivided into generic and according to specialty; (iv) All the possible special investigations that may be required (6 items); (v) the data (6 items) required to determine the outcomes (diagnoses, prognoses and treatment strategy).

Participants were asked to provide a personal opinion on: The relative merits of the current specialist consultation system employed in restorative dentistry and how this would compare against a possible remote consultation system. Results were analysed quantitatively and qualitatively. In this regard, we are specifically seeking to identify and examine any issues which would make an online alternative remote consultation system impractical.

RESULTS

The results show the outcome of the surveys for the four components of the assessment: History *(Table 1)*, clinical assessment *(Table 2)*, special investigations *(Table 3)* and outcomes *(Table 4)*. An average score for each of the questions across respondent type was considered and a Friedman test was conducted on the thirty-six data items according to speciality. The results show that there was a significant difference in the manner the respondents have scored the questions according to speciality [chi-square value of 8.667, which was significant (p= 0.01)]. *(Figure 1)*

EFFECT OF EXPERIENCE ON DATA REQUIREMENTS

A Friedman text revealed that the experience of the consultant (as a function of years in post) had a statistically significant impact on the perceived amount of the data required to undertake the consultation (Chi-square value of 53.313, which was significant p= 0.000) *(Figure 2)*.

Table 1. Data Always needed as patient history by specialty

Data needed from 'History taking'	Endodontics	Periodontics	Prosthodontics	Tooth Wear	RPDs	Complete Denture
Reason for attendance	always	always	always	always	always	always
Presenting complaint	always	always	always	always	always	always
History of presenting complaint	always	always	always	always	always	always
Relevant dental history	always	always	always	always	always	always
Relevant diet history	rarely	rarely	mostly	always	mostly	rarely
Relevant social history	mostly	mostly	mostly	mostly	mostly	mostly

Table 2. Data Always needed during the clinical examination

Data needed from the 'clinical examination'	Endodontics	Periodontics	Prosthodontics	Tooth Wear	RPDs	Complete Denture
Relevant medical history	always	always	always	always	always	always
Intra-oral soft tissue assessment	always	always	always	always	always	always
Visually assessment of whole patient	mostly	mostly	always	always	always	always
BPE	mostly	always	always	always	always	never
Visual assessment of tooth/teeth	always	always	always	always	always	rarely
Present dental status (charting)	mostly	mostly	always	always	always	rarely
Basic occlusal assessment	mostly	mostly	always	always	always	mostly
Tactile assessment of teeth	always	always	mostly	mostly	mostly	rarely
Tooth wear assessment	rarely	rarely	mostly	always	mostly	rarely
Extra-oral TMJ & nodes	mostly	mostly	mostly	mostly	mostly	mostly
Extra-oral soft tissue assessment	mostly	mostly	mostly	mostly	mostly	mostly
Assessment of teeth / restorations with explorer probe	mostly	mostly	mostly	mostly	mostly	never
Alveolar ridge assessment	rarely	rarely	mostly	rarely	always	mostly
Full periodontal assessment	rarely	mostly	mostly	rarely	mostly	rarely
Assessment of RPD (outside the mouth)	rarely	rarely	mostly	mostly	always	rarely
Intra-oral assessment of RPD (by tactile manipulation)	rarely	rarely	mostly	mostly	always	rarely
Assessment of complete denture (outside the mouth)	never	never	rarely	rarely	rarely	always
Intra-oral assessment of complete denture (by tactile manipulation)	never	never	rarely	rarely	rarely	always

Table 3. Data Always needed during the clinical examination

Data needed from 'special investigations'	Endodontics	Periodontics	Prosthodontics	Tooth Wear	RPDs	Complete Denture
PA radiograph	always	mostly	mostly	mostly	mostly	never
Mandibular manipulation into RCP	never	rarely	mostly	mostly	mostly	always
Percussive test	always	rarely	rarely	rarely	rarely	never
Sensitivity testing	mostly	rarely	rarely	mostly	rarely	never
OPG radiograph (prior to selected PA's as appropriate)	rarely	mostly	rarely	rarely	rarely	rarely
Bitewing radiographs	rarely	rarely	rarely	rarely	rarely	never

Table 4. Outcome essential data

Essential 'Outcome' data	Endodontics	Periodontics	Prosthodontics	Tooth Wear	RPDs	Complete Denture
Send a letter report to referring GDP?	always	always	always	always	always	always
Diagnosis(es)	always	always	always	always	always	always
Outline treatment strategy	always	mostly	always	mostly	always	always
Prognosis(es)	mostly	mostly	mostly	mostly	mostly	mostly
Detailed treatment strategy	mostly	mostly	mostly	mostly	mostly	mostly
Send a copy of the letter report to the patient?	mostly	mostly	mostly	mostly	mostly	mostly

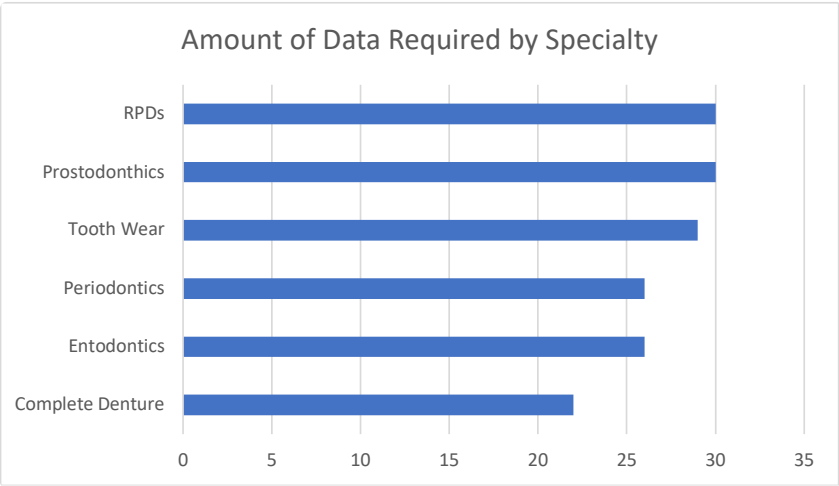

Figure 1: Amount of data required by speciality

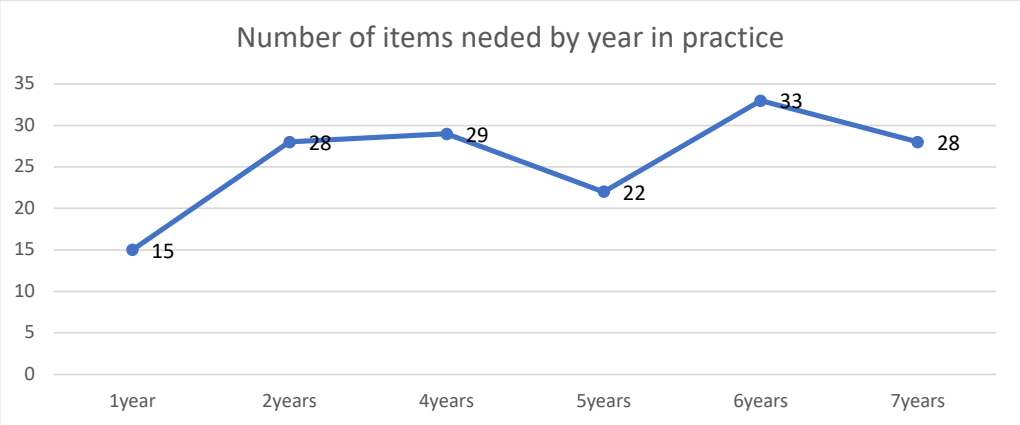

Figure 2: Data required by year in post

RESPONDENT'S VIEWS ON THE CURRENT AND POTENTIAL RCC SYSTEM

Both the consultants and the StRs consider that an advantage of a remote consultation system would be the simultaneous access of the relevant patient data. A clear disadvantage would be the lack of a more visual and more personal experience with the patient.

In addition, the StRs considered advantages to be the creation of instant and automatic reports for the patient and dentist, and the contemporaneous interaction amongst the three parties involved (patient, consultant and dentist). The consultants saw this latter point as a disadvantage *(Tables 4, 5* and *6*).

THEMATIC ANALYSIS OF FREE-TEXT WRITTEN COMMENTS

Perceived disadvantages of the current face-to-face in-person consultation system

- The current system is perceived as not encouraging shared patient care,
- The communication system is considered too complex.
- The referrals often driven by economic factors, the GDP does not see a sufficient return, or because the GDP does not want to treat a difficult patient.

Table 5. Participant opinions of the current referral system 'in-person' system

The current clinical consultation referral system...	Consultants	StR
Provides a timely service to the patient?	yes	yes
Enables the specialist to establish an informed treatment strategy with due consideration to the views of the patient and the referring dentist?	yes	yes
Seems a cost-effective way of providing specialist advice?	yes	yes
Provides a timely service to the referring dentist?	yes	No
Enables a fully informed discussion between the patient, referring dentist and specialist?	No	yes
Considers the need for the patient to travel to a specialist centre?	No	No

Table 6. Participant opinions of a potential remote consultation system

A Remote clinical consultation system ...	Consultants	SPR
Provides a simultaneous access and exchange of all the relevant clinical data sets between the dentist and the specialist.	Advantage	Advantage
Creates an instant, automatic, report for the patient and dentist?	Disadvantage	Advantage
Creates a live, contemporaneous, interactive discussion amongst the patient, dentist and specialist.	Disadvantage	Advantage
Is a more visual and more personable than the current written letter medium between the dentist and specialist?	Disadvantage	Disadvantage

Perceived disadvantages of RCCs in Restorative Dentistry

- Increase of time to conduct the consultation. This could be due to discussions or to the fact one of the party (e.g. the patient) might be late.
- The lack of GDP skills might be embarrassing for the GDP in front of the patients.
- There could be arguments with the GDPs rather than discussion.
- Or the discussion could not be frank as it takes place on front of the patient.
- Unavailability of superfast broadband might limit geographical area of service.
- Inability for the consultants to touch the tissues might cause problems.
- A new financial model needs to be agreed, as the GDP might have to collect the patient's data (e.g. cast) to send to the Consultant, and this might increase costs.

Perceived Advantages for RCCs in restorative dentistry

- The remote consultations could be an opportunity to provide continuous professional development to the GDPs.
- They would allow patients to be treated in their practice, and not sent to the hospital as a solution for uneconomic or difficult patients.
- They are described as beneficial for endodontics as a rapid decision can often be made remotely.

DISCUSSION

This study was designed as an exploratory case study with the primary aim to determine if it is feasible and valid to consider a minimum data set required for conducting remote digital consultations in the various restorative dentistry specialties. It also investigates the opinion of the specialist con consultant on the advantage and disadvantage on the current system and a potential tele-dentistry solution. We sought the views of both established specialist consultants that were routinely undertaking specialist consultations as part of their job and also of trainee Specialist Registrars, that were providing this service under the overall supervision of a named consultant; both in a secondary care centre (eg.: Hospital). We found that it was not feasible to obtain an accurate and contemporaneous list of providers that fell into these two categories. Hence we sought to recruit participants from the specialist societies that supported their activities in the UK; the Association of Consultants and Specialists in Restorative Dentistry (ACCSRD) and the Specialist Registrars in Restorative Dentistry (SRRDG).

Results show that there is a significant difference in the perceived amount and type of data required to conduct a consultation. The nature of the specialty (Endodontics, periodontics or prosthodontics), being a StR or a consultant and the experience (as a function of years in post) impacted on the data requirements. The outcomes are consistent with the need for most clinicians to undertake a comprehensive assessment of all the generic aspects of the assessment (history taking, clinical examination and special clinical investigations). The need to obtain specific data items is in line with the nature of the specialty consultation. Each specialty has its own data requirements, some specialty require less data, such as complete dentures, while the provision of removable partial dentures and fixed prosthodontics require the most data. It appears that the longer a specialist consultant has been in practice, the more data she/he would require; this may be as a reflection on greater understanding of risks and a natural desire to avoid these by undertaking a comprehensive and full assessment. The results from this exploratory study suggest that it is possible to establish specific data requirements for each of the restorative specialties; that consist of common generic components and specialty-specific items.

With regards to the current system and a possible remote consultation system, the consultants are reasonably happy with the current system. The only disadvantage they see is that the patients might have to travel to see the consultants. While StRs preferred the idea of a remote clinical consultation system and they considered that the only possible disadvantage being that the encounter might be less personable between the dentist and the specialist.

There is a clear trend with more data required as individual consultants became more experienced. There is a difference between consultants and trainee grades in their desire to embrace an alternative RCC system. This may be due to the fact that consultants are established in their role, more risk-averse and see RCC as an untested and potentially problematic alternative.

There is a difference between the data requirements of consultants and STRs, where STR need more data points (n=21) against 16 data needed by consultants. the STRs data requirement was the same as for a consultant with five additional points.

Opinions for the current system and a hypothetical remote consultation system, highlighted that consultants are generally satisfied with the current system; reporting patient travel as the only disadvantage. StRs state a preference for a RCC, accepting the potential disadvantage that they might be less personable between the dentist and the specialist.

Also, we have observed that as specialists gain greater experience (as a function of years in post) there was a tendency to require more data.

CONCLUSIONS

The aims of this investigation were met by establishing that it is not valid to establish a fixed or minimum range of criteria or data points that is common to all specialties in restorative dentistry. The second aim is also met, by highlighting the variation of data required (perceived or real) between individuals, as a function of experience and specialty; hence meeting the two hypotheses (H1 and H2). Accordingly, it may not be possible to determine the minimal data set required for a clinical consultation required to be provided to carry out the consultation as per the stated 'baseline standard'.

There is a suggestion that trainee grades (StRs) embrace the concept of a RCC more readily whilst a consultant (more experienced) highlight some of the perils of undertaking a three-way discussion between Patient-GDP-Consultant; these being discussions turning into arguments, longer duration and embarrassment of GDP if not able to engage with consultation.

Based on the above, it is possible to establish the following recommendations for a future implementation of remote clinical consultations in restorative dentistry:

- The data requirements for each of the restorative specialties should consist of common generic components and specific specialty items.
- The electronic data transfer should aim to be as comprehensive as possible, as there is no perceived limitation for either the type and volume of data that could or should be transferred electronically.
- It is important that all secondary care specialists (providing the RCC) should be satisfied that this is as effective and not inferior to an 'in-person' event if they are to universally embrace this concept. This point requires further investigation.

This exploratory study is limited by its breadth of specialist consultants and senior trainee grades. Notwithstanding, it highlights the potential capabilities of a remote consultation process and the perceptions of consultants and specialist registrars in restorative dentistry for both the current consultation system and a hypothetical remote clinical consultation process.

These findings suggest that the data capture process for remote clinical consultations in restorative dentistry is feasible and that it can be tailored to specific sub-specialties. It also suggests that there is tentative acceptance amongst consultants and senior trainee grades in restorative dentistry. Both these points, together with an exploration of the acceptance for this process by other stakeholders (Patients and the referring primary care dentists) should form the basis of future studies.

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