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Supportive technology in collaborative research: proposing the STiCR framework

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ABSTRACT

INTRODUCTION Achieving a standard of clinical research at the pinnacle of the evidence pyramid is historically expensive and logistically challenging. Research collaboratives have delivered high-impact prospective multicentre audits and clinical trials by using trainee networks with a range of enabling technology. This review outlines such use of technology in the UK and provides a framework of recommended technologies for future studies.

METHODS A review of the literature identified technology used in collaborative projects. Additional technologies were identified through web searches. Technologies were grouped into themes including access (networking and engagement), collaboration and event organisation. The technologies available to support each theme were studied further to outline relative benefits and limitations.

FINDINGS Thirty-three articles from trainee research collaboratives were identified. The most frequently documented technologies were social media applications, website platforms and research databases. The Supportive Technologies in Collaborative Research framework is proposed, providing a structure for using the technologies available to support multicentre collaboration. Such technologies are often overlooked in the literature by established and start-up collaborative project groups. If used correctly, they might help to overcome the physical, logistical and financial barriers of multicentre clinical trials.

KEYWORDS
Technology – Research collaborative – Clinical trials – Trainees

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Introduction

Achieving the highest quality of evidence requires well conducted and powerful studies, drawing conclusions from large datasets. Naturally, only a limited dataset can be recruited from one geographical area. This is why research has experienced a paradigm shift towards multicentre randomised controlled trials and audit.[1] Recently, surgical trainees in the UK have been innovators of effective research collaboratives.[2] The National Research Collaborative is a composite of all trainee research collaboratives with those that are surgically themed representing 29 of the 37 listed.[3] The output of such groups is becoming more prominent in the literature.[4] However, lack of adequate funding often precludes the administrative assistance that is pivotal to the execution of a multicentre study. Compounding the lack of infrastructure is a broad geographical radius, sheer numbers, and dynamic location of collaborators. Despite enthusiasm and knowledge, the additive effect of these challenges results in difficulty developing, starting and maintaining a national or international study.

It is our belief that many of these challenges can and are being mitigated by the use of technology. We aimed to perform a literature review of current technologies used by collaborative groups and to subsequently develop a framework, the Supportive Technologies in Collaborative Research (STiCR) framework or toolkit, which can be employed by surgical collaborative project groups to produce sustained and meaningful research output.

Methods

Medical and surgical collaborative groups in the UK were identified using the Idea, Development, Exploration, Assessment, Long-term follow-up (IDEAL) studies collaboration, Research and Audit Federation of Trainees and the Association of Surgeons in Training webpages as a preliminary search. Associated publications and protocols were identified through searches of Medline and EMBASE. The method sections of returned results were analysed to establish first, whether the use of technology was reported by collaboratives; second, which technologies were used; and third, for what purpose. After the identification of articles, the frequency of documented technology was identified.

Results

Thirty-three articles were identified in August 2018. The most frequently documented technologies were websites, social media applications and research databases. Table 1 summarises the results of the review.

The majority of collaboratives have organisational webpages explaining goals and advertising both current and past projects.[5–11] Websites for collaborator recruitment were the most frequently used networking and recruitment tool, seen in 68% of studies. Other strategies included email advertisement to medical school mailing lists and surgical societies. Social media as a promotional or recruitment tool was reported in 32% of the literature.[5–15] The Student Research and Audit in Surgery (STARsurg) and Globalsurg collaboratives were the only groups to report extensive use of social media in their recruitment strategies, predominantly through Twitter with links to Facebook and Youtube.[6,8,12]

While communication methods used by groups were largely omitted from documentation, studies such as the ROSSINI trial[4] used Twitter to facilitate communication among collaborators.[5,8,13,16] STARSurg used Twitter to hold a weekly live online question and answer session for collaborators. The London Surgical Research Group created an online forum for collaborators to share and promote best practice for site recruitment,[15] and collaborators on the WAVE project were added to a WhatsApp group to share problems and solutions.[17] Information dissemination via email to collaborators was a relatively common reported theme.[4,14,17,18] The South West Anaesthesia Research Matrix used the project management software Basecamp.[19]

Research Electronic Database capture (REDcap) software was the most frequently reported tool used for data collection.[5,8,9,15,18,20] Many projects (32%) introduced e-learning modules to provide standardised teaching and assessment on such technologies, hosted on Quizlet[8] and private web servers.[4–10,15,21–25] Alternative online data collection tools included Microsoft Access,[4,24,25] Microsoft Excel,[17] SWAT[26] and ORION.[27] Other projects used simple online survey tools such as SurveyMonkey to gather collaborator opinions and experiences.[8]

In addition, technologies have been used to help organise events including the STARsurg academic research training day and a protocol launch for the Outcomes After Kidney injury in Surgery (OAKS) study.[6,7] Eventbrite appeared to be the application of choice for events management and the use of Periscope facilitated live broadcasting, allowing two-way dialogue with attendees not physically present.

The STiCR Framework

Establishing good technology practice appears to reduce the overall workload and increase the reach and exposure of a project. The phases of a project where prompts to use technology may be useful are: access (A), collaboration (C) and events (E) (Fig 1). Under these headings, technological adjuncts are presented, together with their benefits and limitations, to meet the logistical challenges that have been highlighted from the literature review (see Supplementary file 1 for details, online only).

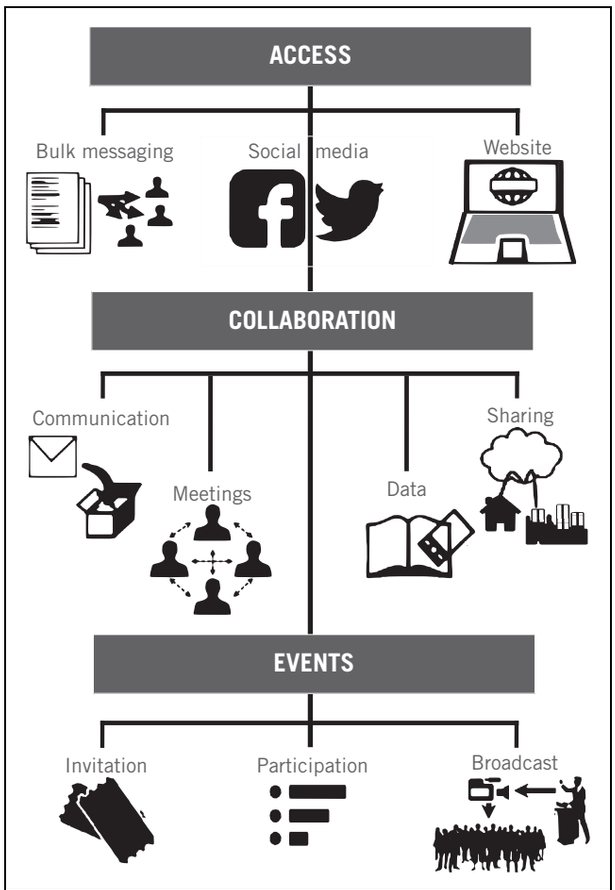

Figure 1 The Supportive Technology in Collaborative Research (STiCR) framework. A diagrammatic representation of the key project areas and proposed framework.

Table 1 Commonly used technologies and identified papers from the review.

Technology	Identified papers	Description
Bespoke e-learning platforms	Pinkney *et al* (2013)[4] Nepogodiev *et al* (2014)[5] Chapman *et al* (2015)[6] StarSurg collaborative (2016)[7] Nepogodiev *et al* (2015)[8] GlobalSurg collaborative (2016)[9] GlobalSurg collaborative (2017)[10] LSRG (2017)[15] RSTN (2015)[16] Aiken *et al* (2013)[17] Hamilton *et al* (2013)[23]	Used during collaborator training to ensure standardised teaching and assessment.
Email	Pinkney *et al* (2013)[4] Nepogodiev *et al* (2014)[5] Chapman *et al* (2015)[6] StarSurg collaborative (2016)[7] Nepogodiev *et al* (2015)[8] Shorrock *et al* (2015)[12] Khatri *et al* (2015)[13] Riddell *et al* (2015)[19] RSTN (2014)[20] NWRC (2014)[22]	Collaborator recruitment and information dissemination once trials were launched.
Webpages	Nepogodiev *et al* (2014)[5] Chapman *et al* (2015)[6] StarSurg collaborative (2016)[7] Nepogodiev *et al* (2015)[8] GlobalSurg collaborative (2016)[9] GlobalSurg collaborative (2017)[10] ISOS (2017)[11]	Designated web pages for specific projects (micro-web pages) or organisational specific web pages used for collaborator recruitment.
RedCap	Nepogodiev *et al* (2014)[5] Nepogodiev *et al* (2015)[8] GlobalSurg collaborative (2016)[9] LSRG (2017)[15] RSTN (2014)[20] NWRC (2014)[22]	Secure electronic data capture platform.
Twitter	Nepogodiev *et al* (2014)[5] Chapman *et al* (2015)[6] StarSurg collaborative (2016)[7] Nepogodiev *et al* (2015)[8] Shorrock *et al* (2015)[12] Lewis *et al* (2014)[18]	Used for collaborator recruitment and to facilitate communication with collaborators once trials were launched.
YouTube	Chapman *et al* (2015)[6] Nepogodiev *et al* (2015)[8] Khatri *et al* (2015)[13]	Used in conjunction with Facebook and YouTube to facilitate collaborator recruitment.
Facebook	Chapman *et al* (2015)[6] Nepogodiev *et al* (2015)[8] Khatri *et al* (2015)[13]	Used in conjunction with Twitter and YouTube to facilitate collaborator recruitment.
Eventbrite	Chapman *et al* (2015)[6] StarSurg collaborative (2016)[7]	Event management software used to engage collaborators via regional meetings.
WhatsApp	Riddell *et al* (2015)[19]	Used to facilitate communication between collaborators once trials were launched.
Basecamp	SWARM (2015)[21]	Project management software used throughout.

A – Access (networking and engagement)

Online networking reduces the need for physical presence in project development and execution. Networking plays an important initial role in recruiting and maintaining engagement with collaborators, providing both information and motivation. Three key technology areas are websites, email and social media (Supplementary file 1, Table 1).

> *Email/bulk messaging*: The management of mailing lists, particularly with the recent enforcement of the European Union General Data Protection Regulation can be a challenge. Dedicated mailing list managers, such as MailChimp, offer a way for recipients to subscribe through online forms, and unsubscribe with ease.

> *Social media*: The design of each social media platform influences the demographic of the recipient. Facebook is the largest of these platforms, with over 2.41 billion monthly users.[29] Twitter, with 330 million monthly users,[30] limits output to 280-character 'tweets' with the intention of providing high-yield information. Despite this limit, it is versatile and embeds well with other online platforms. LinkedIn is largely used for professional networking and, while the user base (467 million users)[31] is smaller in comparison with Facebook and Twitter, the audience is targeted and professional. Collaboratives should use an integration of these platforms to broaden their reach.

C – Collaboration

Effective collaboration involves meetings, document sharing, and smart collection and storage of data (Supplementary file 1, Table 2).

> *Meetings*: Geographical collaborator separation poses logistical challenges with face-to-face meetings being expensive and time consuming. Video conferencing is increasingly used with multiple options (eg Google Hangouts, Skype). Non-verbal communication is an integral part of any social interaction and virtual meetings attempt to preserve this. Reliability is also an issue; lapses in audio and/or video quality can result in participant frustration and potentially unplanned exclusion from meetings. Google Hangouts benefits from a large range of add-in apps that can increase communicability. Features such as user name/role bars, recording, polling, screen share (ie allowing other to view your screen) and presenting slideshows. Zoom has many premium group meeting features in its non-paid plan but has a 40-minute time limit to meetings.
> *Communication*: In addition to meetings, written recordable communication between sub-groups is improved by software options such as Slack or Basecamp.[3] These developments allow the creation of multiple teams, personalisation of notifications to reduce clutter and to-do lists. They also allow for integration with social media and Google Drive storage to facilitate document sharing. These technologies also provide oversight for project leaders in tracking task completion and collaborator contribution, preventing stagnation and ensuring accountability. WhatsApp is ubiquitous but lacks many features that make a strong group collaborative communication option.
> *Electronic data collection*: Electronic data collection uses web surveys or realtime databases to record information. These offer advantages over paper-based capture techniques: reduced collection time, decreased administration cost, improved data accuracy, incorporation of multimedia and branching logic. Their disadvantages are predominantly bias and security of data.[32,33]

The REDCap web-database is designed for small to medium scale medical research projects,[32] but many other platforms exist, such as ClinCapture, and very simple non-medical solutions such as Google Forms, Doodle and SurveyMonkey. Features of the medically focused systems include randomisation of trial participants, mobile phone optimisation and built-in calendars to schedule follow-up questionnaires. Data security is paramount when confidential/patient information is being held and in such scenarios only the more sophisticated systems will suffice. Audit trails generated by user logins is a useful additional feature to maintain quality and accountability.

> *Sharing documents digitally*: Email can provide encrypted file exchange, albeit limited by attachment file size. As data volume has increased with big datasets the need for file distribution has borne specialist services such as DropBox, Google Drive or Microsoft Office 365, all offering dynamic collaboration.

E – Events

Collaboratives hold events to share ideas and raise awareness of results. Software can aid all aspects of event management, from initial invitation, ticketing to increasing participation among collaborators in attendance and broadcasting (Supplementary file 1, Table 3)

> *Invitation*: Management software exists to facilitate event invitation through registration and ticketing of attendees. EventBrite is a frequently used, comprehensive platform offering an intuitive mobile application, the choice of hosting private events and the option to enable seating reservation. However, platforms such as Picatic and SimpleTix offer integration with other software platforms such as Google Analytics and Groupon.
> *Live streaming events*: Broadcasting events can widen the access to those unable to attend and facilitates interaction not just between the audience and the speaker but between the physical audience and remote users in different countries. It also allows such interactions to be captured and archived where appropriate. A principal challenge, however, is that of privacy. YouTube Live allows a 'private' setting, where it is possible to restrict access to the live stream, with attendees added by email. Similarly, YouTube offers real time analytics with broadcasters able to post web links and interactive polls to encourage audience participation.
> *Participation*: Audience participation at physical events is sometimes limited, due to unwillingness of attendees to voice their views in front of large audiences. Software allows the integration of polling and realtime comments during live streaming, promoting audience participation. Poll Everywhere allows integration with presenting software such as Microsoft PowerPoint and Apple's Keynote, with

automatically updated graphs and word clouds devised from audience comments. Poll Everywhere offers a profanity filter and moderation feature to prevent the topic of discussion devolving, yet human intuition and creativity might prevail over such censoring.

Discussion

Technology is breaking down the barriers to large-scale collaborative research. Trainees are ideally placed to pioneer the use of such technologies as they are often 'tech-savvy' and motivated. The Reconstructive Surgical Trials Network, among other collaboratives, has used technology to develop frugal multicentre studies that remain scientifically robust. It is vital that both established and new collaboratives learn and build from experiences of others; this framework used correctly amplifies the effectiveness of trainee research and increases the breadth of studies which directly translate into changes to clinical practice.

At each phase of the STiCR framework there are options allowing researchers to match the technology to the project. For example, those with strong institutional support may choose REDCap for data collection, whereas those planning a national staff survey without the need for absolute data security may use SurveyMonkey.

The STiCR framework offers the opportunity for innovation with add-on technologies. With increasing connectivity and access to technology there may be unexpected advances in the design and execution of large-scale collaborative projects; for example, including the involvement of communities in the developing world, who through lack of resources and physical proximity are often excluded from research.

Acknowledging the benefits of supportive technologies also reminds authors to document their use. Many published articles omit these details where online study protocols state their use. Focusing on the technologies as a framework also begins to provide a blueprint for one overarching software package capable of coordinating all elements of a collaborative project. The benefits of such a system must outweigh those of the versatility delivered by the varied options available.

Technology and virtual communication tend towards making research faceless and impersonal. Real value and evolution happen when a technology recreates the 'same room' feel on a large scale, not just connecting people but making those connections lifelike. Whether this is through improvements in audiovisual quality such as high definition video, three-dimensional and surround sound, or possibly more futuristic ideas, such as analysis of typing behaviour and transmission of physiological signs, has yet to be determined. Either way, the trainee collaboratives movement is one that should be embraced and supported by the correct technology to further advances in healthcare.

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