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TECHNICAL NOTE

Telemedicine: Potential applications in epidemic situations

Télémédecine : applications potentielles en situations épidémiques

R. Ohannessian

Université Lyon 1, 43, boulevard du 11-Novembre-1918, 69100 Villeurbanne, France

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Summary
Background. — Telemedicine has several applications regarding different medical specialties or clinical situations. However, telemedicine as a potential tool during epidemics is not as well considered.
Methods. — In this paper, the application of telemedicine is conceptualised using five possible evidence-based epidemic situations.
Results. — The first situation corresponds to asymptomatic individuals, mainly home-based, living in an epidemic-affected location. The application of telemedicine would be through the use of teleconsultation for emergency medical dispatching and would occur when suspicious symptoms are detected by an individual. The second situation for the application of telemedicine is principally home-based and corresponds to the follow-up telemonitoring of asymptomatic individuals identified as case contacts. Concrete applications of these concepts were used during the Ebola virus disease outbreak in Africa since 2014. The third situation links to symptomatic cases in need of isolation. Examples include patients isolated in Taiwan during SARS epidemic in 2003 and H1N1 pandemic influenza in 2009, as well as H7N9 influenza infected patients in 2013 in China. The fourth situation involves tele-expertise when local medical resources do not have the technical expertise for the diagnosis or treatment of a patient and support is required from reference centres. The fifth situation corresponds to a healthcare facility under quarantine that would use telemedicine to keep taking care of patients that cannot access the facility, as it was the case in June 2015 in Seoul during the Middle East Respiratory Syndrome Coronavirus epidemic.
Conclusion. — The use of telemedicine in epidemic situations has a high potential in improving epidemiological investigations, disease control, and clinical case management. However, since

E-mail address: Robin.ohannessian@gmail.com

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it is a recent application, further research would be needed to gain an improved understanding of how telemedicine could be applied in epidemic situations.
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MOTS CLÉS
Télémédecine:
Épidémie ;
Cas groupé ;
Contrôle ;
Maladie à virus Ebola ;
Santé globale

Résumé
Contexte. — La télémédecine a de nombreuses applications selon les spécialités médicales et les situations cliniques. Cependant, la télémédecine comme potentiel outil en situations épidémiques a été peu considérée jusqu'à présent.
Méthodes. — Dans cet article, l'utilisation de la télémédecine en cas d'épidémies a été conceptualisée en fonction de cinq situations épidémiques différentes fondées sur les faits.
Résultats. — La première situation correspond au cas où la téléconsultation est utilisée avec une personne asymptomatique vivant à domicile dans une logique de régulation médicale d'urgence. La deuxième situation épidémique concerne l'utilisation de la télésurveillance pour le suivi régulier des personnes identifiées comme contacts de cas. De nombreuses applications mettant en pratique ces concepts ont été utilisées lors de l'épidémie de maladie à virus Ebola en Afrique depuis 2014. La troisième situation est en lien avec la nécessité d'isolation de patients malades et la réalisation de téléconsultations. Ce fut utilisé notamment à Taiwan en 2003 lors de l'épidémie de SRAS et en 2009 lors de la pandémie grippale à virus influenza H1N1, ainsi qu'en Chine en 2013 pour des patients infectés par le virus influenza H7N9. La quatrième utilisation est la télé-expertise au cas où les ressources médicales locales ont besoin d'un support extérieur et d'une aide technique pour le diagnostic ou la prise en charge d'un patient. La cinquième situation correspond au cas où un établissement de santé serait en quarantaine et pourrait utiliser la télémédecine pour continuer à prendre en charge les patients ne pouvant accéder à l'établissement, comme ce fût le cas en juin 2015 à Séoul pendant l'épidémie de Coronavirus du Syndrome Respiratoire du Moyen-Orient.
Conclusion. — L'utilisation de la télémédecine lors de situations épidémiques a un intérêt pour améliorer les investigations épidémiologiques, le contrôle de la maladie, et la gestion médicale des cas. Cependant, cette application de la télémédecine étant récente, des recherches supplémentaires seraient nécessaires afin d'obtenir une meilleure compréhension de la façon dont la télémédecine pourrait être utilisée en cas d'épidémie.
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Telemedicine is often regarded as a way to improve the management of chronic diseases [1,2] and assist emergency medicine [3,4]. However, using telemedicine as a potential tool during epidemics is not as well considered. The objective of this paper is to conceptualize the use of telemedicine during epidemics using five possible evidence-based situations and associated concrete examples.

The first situation corresponds to asymptomatic individuals, mainly home-based, living in an epidemic-affected location. The application of telemedicine would be through the use of teleconsultation with a remote medical service. The primary role of the application would be emergency medical dispatching and would occur when suspicious symptoms are detected by an individual. Teleconsultation would be conducted using text, audio and/or video and would allow a personal risk assessment to determine whether the patient has a matched case definition or not. When symptoms match with the case definition, a secured transport would be issued and sent to the patient's location in order to safely transfer the patient to a referral treatment centre. When symptoms do not match with the case definition, the patient may be advised to seek a primary care physician.

In 2014, during the Ebola virus disease (EVD) outbreak, the Ministry of Health in Guinea set a National Ebola Hotline to respond to public health concerns and facilitate the referral of suspected cases to the isolation ward at Donka hospital in Conakry [5,6]. Similar hotlines were set up in Liberia [7] and Sierra Leone as well [8]. Furthermore, teleconsultation has been used in West Africa through a free telemedicine mobile application allowing people to send free text messages to seek medical advice [9,10]. Doctors for this initiative were based in Indonesia and Nigeria and once symptoms were matched with case definitions, patients were advised to seek medical treatment. From October 2014 to May 2015 included, 6063 live chats concerning Ebola occurred, with 20 suspicious cases detected.

The second epidemic situation for the application of telemedicine is principally home-based and corresponds to the follow-up monitoring of asymptomatic individuals identified as case contacts. Telemonitoring is managed through an auto-administered or hetero-administered online/mobile based questionnaire system. Collected medical data are then sent to a contact tracing centre. This system could

potentially be coupled with the contact geo-localisation to facilitate the monitoring process. In current practice, the contact's medical status is regularly monitored by an epidemiologist throughout the defined follow-up duration. With the use of telemonitoring, current practice may be improved. The advantages of telemonitoring would be increased time and human ressources as well as improving real-time data management and targeted intervention.

In Guinea, telemonitoring has been used since 2014 through the open source mobile platform application for contact tracing deployed by the United Nations Population Fund (UNFPA) [11,12]. Other examples of telemonitoring use during the EVD epidemic include the smartphone mobile application tested in Sierra Leone in partnership with Innovations for Poverty Action (IPA), the International Medical Corps, and the London School of Hygiene and Tropical Medicine, and supported by the United Nations Mission for Ebola Emergency Response (UNMEER) [13], as well as an integrated platform based on Open Data Kit and Form Hub technology in Nigeria [14].

Furthermore, in Western Australia, in 2014, the concept of telemonitoring directed the development of an SMS-based mobile application named ''EbolaTracks'' for monitoring individuals returning from Ebola-affected countries in Africa. Those potentially exposed to the virus were monitored via text message twice a day to identify the health status of patients, including their temperature. During the follow-up, 1108 messages were sent to 22 participants to solicit symptom information with a 91% return rate [15].

The third epidemic situation links to symptomatic cases in need of isolation, whether in a healthcare or home environment. The use of teleconsultation may reduce the exposure time between a healthcare worker and an infectious patient while still allowing a rigorous medical check-up process. When face-to-face consultations are required, the use of teleconsultation would not disturb clinical examinations and/or medical intervention. In an epidemic situation, the use of teleconsultation could thus provide a reduction in healthcare-associated infections and improve disease control.

Teleconsultations were used in Taiwan in 2003 during the Severe Acute Respiratory Syndrome (SARS) epidemic [16] concerning a hospital quarantined SARS-affected patient [17,18], and in 2009 during the H1N1 influenza pandemic for home-quarantined patients [19]. Teleconsultation was also used in China in 2013 with a H7N9 influenza infected patient hospitalised in Beijing Ditan Hospital [20,21], and in the USA in 2014 at the Biocontainment Patient Care Unit in the Nebraska Medical Center for an Ebola-infected patient returning from West Africa and confined to the isolation ward [22].

The fourth situation for the application of telemedicine in epidemic outbreaks involves tele-expertise. Tele-expertise has potential when local medical resources do not have the technical expertise for the diagnosis or treatment of a patient and when support is required from reference centres. Tele-expertise is primarily useful in healthcare settings of primary and secondary care levels. The four situations are modelled in Fig. 1.

The fifth situation corresponds to a healthcare facility under partial or complete quarantine that would use telemedicine to keep taking care of patients that cannot access the facility. In June 2015, the Samsung Medical Center in Seoul (South Korea) was allowed to use teleprescriptions while being under quarantine [23,24] due to the Middle-East respiratory syndrome (MERS) Coronavirus epidemic [25,26].

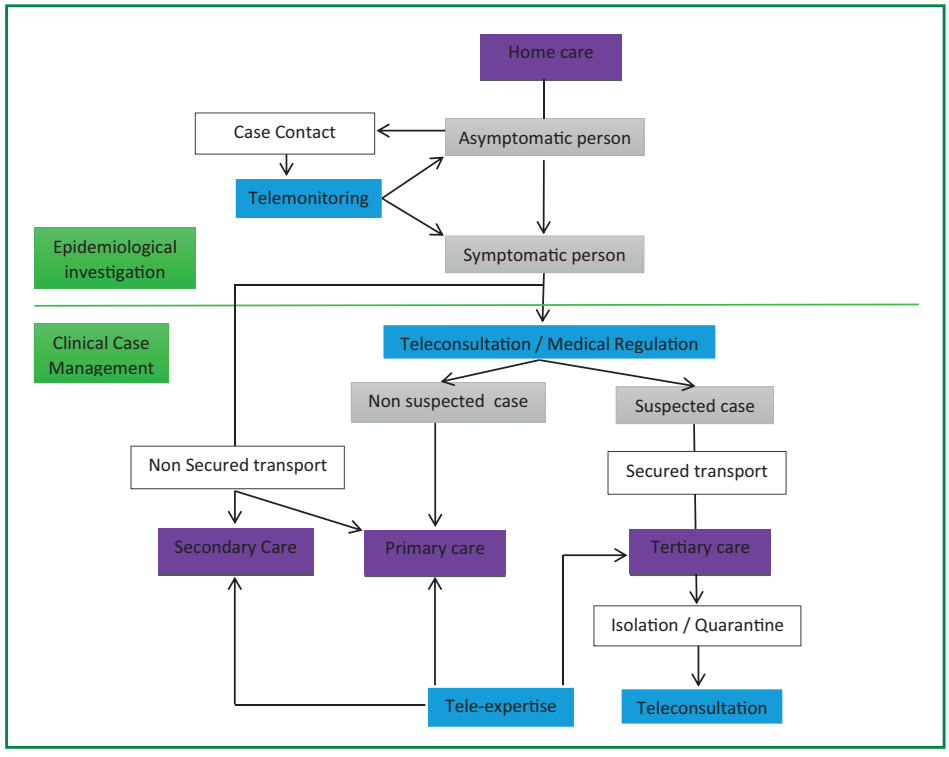

Figure 1. Potential use of telemedicine during epidemics.
Utilisation potentielle de la télémédecine en cas d'épidémies.

Telemonitoring and teleconsultations could also have been used for patients that were not allowed to be admitted into the hospital.

The use of telemedicine in epidemic situations has a high potential in improving epidemiological investigations, disease control, and clinical case management, while allowing the global health community to support local caregivers. Further research would be needed to gain an improved understanding of how telemedicine could be applied further in epidemic situations.

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Disclosure of interest

The author declares that he has no conflicts of interest concerning this article.

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