POTENTIAL ROLE OF EMERGENCY MEDICAL SYSTEM CALL CENTRES IN EPIDEMIOLOGICAL SURVEILLANCE OF SEASONAL INFLUENZA

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SUMMARY

Objectives: Seasonal influenza causes high morbidity worldwide and high mortality in developing countries. As a result, the development of systems for seasonal influenza surveillance has been of great interest. The aim of this study is to explore the potential role of an Emergency Medical System (EMS) call centre to complement traditional surveillance systems of seasonal influenza.

Methods: Retrospective observational study in which data on influenza from the system of Notifiable Diseases List (Spanish acronym EDO) and Sentinel Physicians Network (Spanish acronym RMC) were compared with information on calls made to the Principality of Asturias EMS call centre that covers all the region population (1,027,659 inhabitants) based on a set of specific criteria to determine differences and explore this emergency call system as a complementary epidemiological surveillance system. Cases registered by different systems have been compared to the same 68 weeks period, from week 45 of 2011 to week 8 of 2013.

Results: RMC reported a total of 2,354 cases of influenza, EDO 43,071 cases and EMS call centre 4,360 "case calls" out of 180,720 total emergency calls. Case series of EDO and EMS call centre have shown a positive correlation ($R = 0.42$, $p = 0.003$). Case series from EMS call centre and RMC were correlated ($R = 0.38$, $p = 0.007$). Case series from EDO and RMC have shown a strong positive correlation ($R = 0.91$, $p < 0.001$). Correlation analysis of the cases reported by the three systems have shown a significant positive correlation between them ($p < 0.001$). The spike of EMS calls related to the studied influenza syndrome occurs one week in advance compared to traditional epidemiological surveillance systems.

Conclusions: EMS call centre data on influenza could be potentially used as a complementary surveillance system to the traditional epidemiological surveillance systems for influenza.

Key words: public health surveillance, emergency medical service, influenza, surveillance system

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INTRODUCTION

Influenza is an acute viral communicable respiratory disease. Despite being a historically familiar disease, each influenza season presents challenges for healthcare systems due to influenza virus variability. Influenza is responsible each year for a significant morbidity in children and youth, as well as a non-negligible mortality in the elderly and/or people already suffering from an underlying disease (1, 2). As with other communicable disease, the use of influenza surveillance systems for prevention and control is very important. Rather than justification of the need for surveillance the key point is the effectiveness with which the surveillance is carried out (3).

Spain added influenza to the system of Notifiable Diseases List (Spanish acronym EDO) in 1904. During the 1970's national influenza reference centres were created in various regions of Spain. These centres allowed the characterization of the circulating virus, but with little representativeness. Since 1980, when they have been more developed, we have a more representative characterization of circulating viruses each season. The need for greater sensitivity and specificity encouraged the authorities to implement a new system in the mid-90s, based on surveillance through the Sentinel Physicians Network (Spanish acronym RMC).

Currently the influenza surveillance is performed at various levels: regional, national, European and global. In Spain, at the regional and national level, surveillance is done by the Notifiable Diseases System, additionally in 16 regions, including the Principality of Asturias, this system is supported by the Network of Sentinel Physicians. This information is processed by the Carlos III Institute of Health, under the Ministry of Health, based in Madrid.

The Sentinel Physicians Network gets information from a network of volunteer doctors working in primary health care of both family medicine and paediatricians. This information is further transmitted to the European level, the European Influenza Surveillance Network (EISN), a system created in 1992 under the auspices of the World Health Organization and this surveillance is currently carried out in 28 EU countries.

There are 1,077,360 people living in Asturias, representing 2.3% of the total population of Spain (47,270,000 inhabitants) (4). Healthcare is covered mainly by the public sector, resulting

in a free of charge system with good accessibility. The public provider is called SESPA, which provides a primary care alongside a hospital care network. The primary care network in Asturias is comprised of 69 health centres arranged within 68 health areas, with 91 on-call points and 12 emergency primary care units. The hospital network comprises 9 head hospitals. In cases where a patient cannot reach either the emergency primary or hospital care networks, they must call the unified emergency call centre: 112 Asturias. Calls related to health have their basic data collected before being transferred to the Emergency Medical System (EMS, Spanish acronym SAMU) if necessary. The Emergency Medical System follows a set of questions to ascertain the diagnosis of the caller. These questions aim to classify and summarise the call using a range of codes. The call then goes to the coordinator physician who has the responsibility to determine what type of resource is most appropriate to resolve the request filed by the caller.

Despite a lack of study, there is a direct link between public health and emergency medical systems: public health can use data collected from Emergency Medical Systems, and EMS can be assessed from a public health perspective (5). The use of EMS data by the public health system has seldom been studied (6), but some investigations addressed this relationship (7). Recently a new study has been published to compare different surveillance systems regarding syndromic influenza surveillance (8), and some investigations have been developed in emergency departments (9, 10).

The aim of this study is to explore the potential role of the Emergency Medical System call centre of the Principality of Asturias (Spain) to supplement traditional epidemiological surveillance systems for seasonal influenza by comparing data provided by the emergency calls related to flu syndrome and data from EDO and RMC traditional surveillance systems.

MATERIALS AND METHODS

This is an observational retrospective study in which the results of two traditional systems of epidemiological surveillance, the system of Notifiable Disease List and Sentinel Physicians Network system of influenza are compared with information from emergency calls made to the EMS call centre to determine their differences and explore its ability as a complementary surveillance system.

We have established influenza case definition based on a combination of international clinical definitions of influenza and the codes used to classify calls in the EMS call centre. The latest WHO definition is: "Acute Respiratory Disease, temperature ≥ 38 °C and cough with an onset in the last 7 days" (11). The European Centre for Disease Prevention and Control (ECDC) defines the clinical aspects suggestive of influenza as one that meets the following: sudden or abrupt onset of fever; and/or at least one systemic symptom: malaise, headache and myalgia; and at least one of the following three respiratory: cough, sore throat, shortness/difficulty breathing during the epidemic period (1). We must also take into account the definition used by the RMC and EDO in Asturias. The first one, defines influenza case as one that fits the characteristics proposed by ECDC, while the EDO system proposes no different characterization to existing ones, only notes that at the slightest suspicion must declare the case.

After studying the definitions and codes that are used in the EMS call centre to classify calls, we have decided that the calls that are going to be used as "compatible" with influenza, so called "case calls", would be those coded as: headache, cold/cold, sore throat, ocular pain, back pain, fever, and sudden onset.

The variables studied were: weekly influenza cases detected by the RMC system meeting their criteria; weekly influenza cases detected by the EDO system (notifications of suspected influenza cases done using that system); calls made to the EMS call centre and their classification in the following categories: headache, cold, sore throat, ocular pain, thoracic, fever, and sudden onset; age in groups (0–4, 5–14, 15–64 and > 65 years); week number in which notifications or calls occur (division of the year into weeks, ISO 8601:2004 standard was used); and symptoms (RMC) collected by the RMC in their reports (fever, sudden onset, myalgia, general malaise, headache, cough, sore throat, dyspnoea, chills, contact with a confirmed influenza case, and a lack of data).

Temporal period of this study is 68 weeks (from week 45 of 2011 to week 8 of 2013). We used this period because it allows us to study from the peak of the 2011–2012 influenza season, and almost half of the 2012–2013 season, period that we consider enough to cover most of the relevant impact. The study of two different influenza seasons for which influenza viruses are not necessarily identical is useful to reinforce the potential findings of this model. The Sentinel Physicians Network makes an influenza surveillance period of 33 weeks a year, so of the total of our 68 weeks of study, we find that we have data for the three systems – objects of the study for a period of 49 weeks.

An analysis of parametric and non-parametric correlations with log transformation to know if there is a proper relation between the different series was performed. The statistical analysis of data was made with the IBM ® SPSS Statistics program V21.

Regarding the ethical aspects of the study, data collection was conducted using aggregate data. The declaration made by the RMC and EDO system is performed by numerical statements providing information such as age, sex and main symptoms but without recording any data that allow the identification of the patient. Meanwhile, data from the EMS call centre, after the processing performed by the staff of the centre, was delivered just knowing the following variables for each call: date and time of the call, age, sex, and codification, meeting all times the provisions of Law 15/1999 of December 13 regarding the protection and treatment of data.

RESULTS

The RMC system, throughout our study period (49 out of 68 weeks because there is a time period in which there is no surveillance in this system), reported a total of 2,354 cases of influenza. The EDO system reported a total of 43,071 cases in the same period, resulting in a weekly average of 641 cases. The EMS call centre received a total of 4,360 calls in these 49 weeks, encoded in any of the following reasons: head cold/cold, sore throat, ocular pain, thoracic, fever or home abrupt. These are the "case calls". In our study period, SAMU Asturias call centre received a total of 180,720 calls asking for medical care, representing a weekly average of 3,688 calls.

Figure 1 shows the distribution of the cases recorded by the three systems over the studied period. To facilitate reading, cases of the EDO system are represented as the fraction 1/10 of declared.

Case series of the EDO and EMS call centre systems (Fig. 2) show a positive correlation ($R = 0.42$) statistically significant

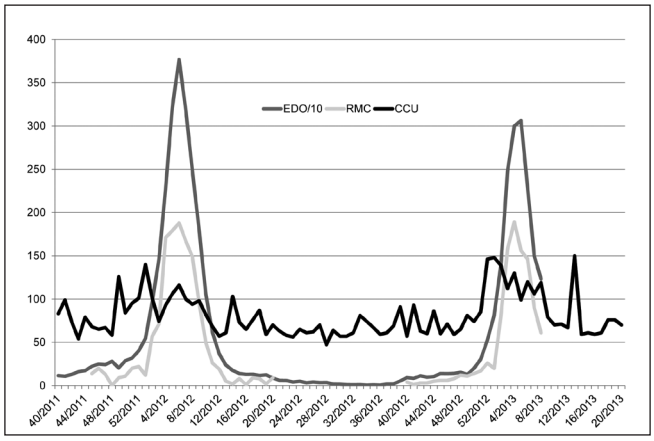

Fig. 1. *Influenza potential cases reported by three surveillance systems (EDO, RMC, CCU).*

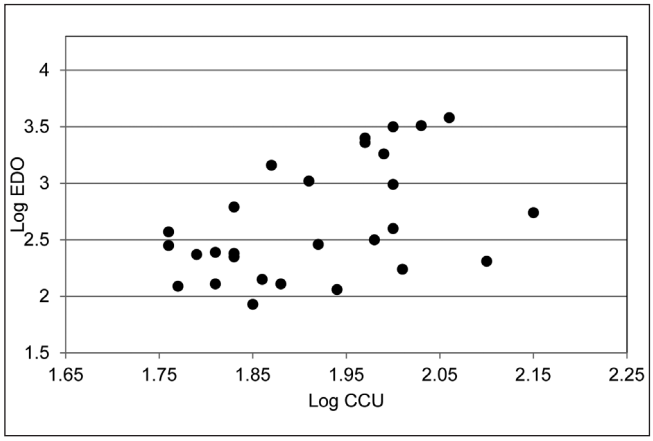

Fig. 2. *Scatter plot of reported cases in EDO and EMS call centre (CCU).*

(p=0.003). Case series of the EMS call centre and RMC are correlated (R=0.38) and statistically significant (p=0.007). Figure 3 shows the scatter plot between these two series. Case series of the EDO and RMC have a strong positive correlation (R=0.91) statistically significant (p<0.001).

The parametrical and non-parametrical analysis of the cases of influenza reported by the three systems (RMC, EDO and

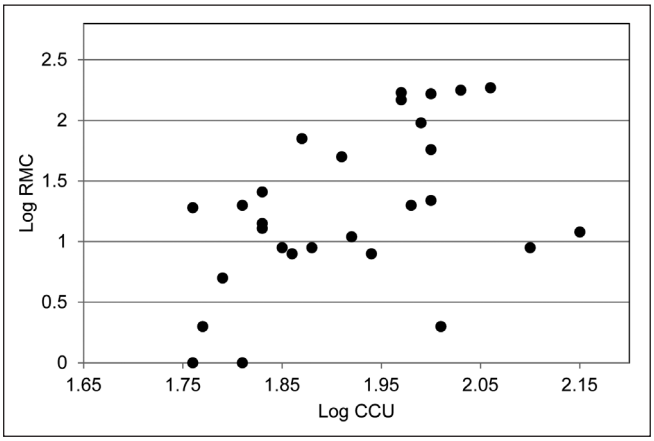

Fig. 3. *Scatter plot of reported cases in RMC and EMS call centre (CCU).*

EMS call centre) for 49 weeks (excluding the summer months in the system RMC not collected data) show significant positive correlation (p<0.001) between the three sets of data as shown in Table 1. The correlation is particularly high in case of EDO and RMC series.

DISCUSSION

Syndromic surveillance systems are based on patients reporting to emergency department or primary care physicians to detect changes in normal disease occurrence pattern (12). Even automatic outbreak detection systems have been developed (13). The importance of surveillance systems for public health has been broadly demonstrated. A review of 35 articles has been published (14) in order to review studies that evaluated outbreak detection through automated surveillance systems. This is the first study using data from an Emergency Medical System call centre to explore its potential usefulness in the epidemiological surveillance of seasonal influenza.

Regarding dependent factors of the outbreak, there are articles that demonstrate factors such as the pollen concentration, and the day of the week in question, depending on whether it is a holiday or not, which may have influence and therefore must

Table 1. *Parametric and non-parametric correlation analysis of cases reported by EMS call centre, EDO and RMC*

		Correlation (p-value)		
		EDO	**RMC**	**EMS call centre**
Pearson R	EDO	1	0.912 (<0.001)***	0.420 (0.003)**
	RMC	0.912 (<0.001)***	1	0.380 (0.007)**
	EMS call centre	0.420 (0.003)**	0.380 (0.007)**	1
Kendall Tau	EDO	1	0.786 (<0.001)***	0.451 (<0.001)***
	RMC	0.786 (<0.001)***	1	0.481 (<0.001)***
	EMS call centre	0.451 (<0.001)***	0.481 (<0.001)***	1
Spearman Rho	EDO	1	0.915 (<0.001)***	0.656 (<0.001)***
	RMC	0.915 (<0.001)***	1	0.657 (<0.001)***
	EMS call centre	0.656 (<0.001)***	0.657 (<0.001)***	1

**Correlation significant at 0.01 level (two sides); ***correlation significant at 0.001 level (two sides).

be taken into account in models of syndromic surveillance (13). Also, real time surveillance systems have been developed (15). In our study we assume that it could be feasible to develop in the future automatic surveillance systems related to different acute communicable diseases according to a combination of different symptoms, using the daily emergency calls.

Regarding syndromic surveillance and mobilization of health resources (ambulances) there are very few previous studies. In two articles, both agree that ambulance dispatches and notifications of influenza in cities that have conducted studies showed similar patterns and the system has high sensitivity detection (16, 17). This is congruent with our findings. However, most surveillance systems based on telephone calls are mainly related to health telephones helplines, instead of emergency call centre as in our study (18). This shows the feasibility of developing syndromic surveillance systems based on emergency calls, which probably would be more efficient because it is not necessary to create new phone systems as parallel call centres.

The EMS have usually been related to quick response to acute emergencies. However, the huge quantity of health data managed by emergency call centres in real time makes necessary to study the relationship between public health and the EMS as a surveillance system that complement other traditional surveillance systems. There have been previous studies showing that ambulance dispatch could be used as a surveillance system for influenza (16) or as general early warning system (19).

In our system we use calls to the emergency call centre as a potential tool for epidemiological surveillance with the limitation that they are related to individual personal complaints of the patient. However, this fact, which could be interpreted like a limitation, is an advantage in the sense that you use your daily emergency call centre as a surveillance system, and you do not have to create new structures to develop a surveillance system. Also, the fact that you use personal physical complaints makes it to be well adapted to real data and trends.

When analysing our data, it is expected to find a strong correlation between the EDO and RMC, because those are systems used and tested to monitor influenza with very good results for many years in Spain. However, correlation between "case calls" and EDO and "case calls" and RMC demonstrate the relationship between calls to the emergency call centre and surveillance for influenza. This correlation is even stronger by the fact that we have used two seasonal influenza periods with different biological patterns.

CONCLUSIONS

Emergency call centre could be potentially used to complement epidemiological surveillance of seasonal influenza and perhaps some other acute communicable diseases if a set of proper symptoms and complaints is found and coded in the call centre. In term of temporal trends, it seems that our emergency call centre detects one week in advanced the peak of the seasonal influenza, related to the EDO and RMC. This aspect is important in order to manage and plan resources in primary health care, hospital care and emergency care. However, it probably could not be used alone as a surveillance system unless automated detection system is developed as a software to be implemented in the same software that manage daily emergency calls.

Conflict of Interests
None declared

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REFERENCES

1. World Health Organization; European Center for Disease Prevention and Control. Annual influenza meeting 2012. Stockholm; 2012.
2. Kyncl J, Havlickova M, Nagy A, Jirincova H, Piskova I. Early and unexpectedly severe start of influenza epidemic in the Czech Republic during influenza season 2012-13. Euro Surveill. 2013;18(6). pii: 20396.
3. De Mateo S, Larrauri A, Mesonero C. Infuenza surveillance: new solitions to an old problem. Gac Sanit. 2006;20(1):67-73. (In Spanish.)
4. CES. Social and economic situation in Asturias 2012. Oviedo; 2012. (In Spanish.)
5. McIntosh BA, Hinds P, Giordano LM. The role of EMS system in Public Health in emergencies. Prehosp Disaster Med. 1997;12(1):30-5.
6. Dunford JV, Chan TC. EMS and Public Health. In: Brennan JA, Krohmer JR, editors. Principles of EMS Systems. Boston: American Collegue of Emergency Phisicians, USA; 2005.
7. Triple S. Assesment of syndromic surveillance in Europe. Lancet. 2011;378(9806):1833-4.
8. Rosenkötter N, Ziemann A, Riesgo LG, Gillet JB, Vergeiner G, Krafft T, et al. Validity and timeliness of syndromic influenza surveillance during the autumn/winter wave of A (H1N1) influenza 2009: results of emergency medical dispatch, ambulance and emergency department data from three European regions. BMC Public Health. 2013;13:905. doi: 10.1186/1471-2458-13-905.
9. May LS, Griffin BA, Bauers NM, Jain A, Mitchum M, Sikka N, et al. Emergency department chief complaint and diagnosis data to detect influenza-like illness with an electronic medical record. West J Emerg Med. 2010;11(1):1-9.
10. Schrell S, Ziemann A, Garcia-Castrillo Riesgo L, Rosenkötter N, Llorca J, Popa D, et al.; SIDARTHa Project Consortium. Local implementation of a syndromic influenza surveillance system using emergency department data in Santander, Spain. J Public Health (Oxf). 2013 Sep;35(3):397-403.
11. World Health Organization. WHO global technical consultation: global standards and tools for influenza surveillance. Geneva: WHO; 2011.
12. Mandl K, Overhage JM, Wagner MM, Lober WL, Sebastiani P, Mostashari F, et al. Implementing syndromic surveillance: a practical guide informed by the early experience. J Am Med Inform Assn. 2004;11:141-50.
13. Wang L, Ramoni MF, Mandl KD, Sebastiani P. Factors affecting automated syndromic surveillance. Artif Intell Med. 2005;34(3):269-78.
14. Buckeridge DL. Outbreak detection through automated surveillance: a review of the determinants of detection. J Biomed Inform. 2007 Aug;40(4):370-9.
15. Tsui FC, Espino JU, Dato VM, Gesteland PH, Hutman J, Wagner MM. Technical description of RODS: a real-time public health surveillance system. J Am Med Inform Assoc. 2003 Sep-Oct;10(5):399-408.
16. Coory MD, Kelly H, Tippett V. Assessment of ambulance dispatch data for surveillance of influenza-like illness in Melbourne, Australia. Public Health. 2009 Feb;123(2):163-8.
17. Mostashari F, Fine A, Das D, Adams J, Layton M. Use of ambulance dispatch data as an early warning system for communitywide influenza illness, New York City. J Urban Health. 2003 Jun;80(2 Suppl 1):i43-9.
18. Rolland E, Moore KM, Robinson VA, McGuinness D. Using Ontario's "Telehealth" health telephone helpline as an early-warning system: a study protocol. BMC Health Serv Res. 2006 Feb 15;6:10. doi: 10.1186/1472-6963-6-10
19. Bork KH, Klein BM, Molbak K, Trautner S, Pedersen UB, Heegaard E. Surveillance of ambulance dispatch data as a tool for early warning. Euro Surveill. 2006;11(12):229-33.

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