MIGRATION TO 112

EUROPEAN EMERGENCY NUMBER IN THE TUSCANY REGION, ITALY

Emergenza 112

Soccorso Sanitario

REGIONE TOSCANA

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EUROPEAN EMERGENCY NUMBER ASSOCIATION

MIGRATION TO 112

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Table of Contents

Executive Summary

This document explores the migration to 112 in the Tuscany region in light of the contextual situation surrounding emergency services in Italy.

As a country that has used 112 historically for only one emergency service (the national military police), the transition to 112 for all emergency services had unique challenges. This document outlines the contextual situation of the move to 112 in Italy, the structure of emergency call handling in Italy, the full transition process to 112, as well as data on the success of this transition. It demonstrates how a single emergency number can streamline the emergency response as well as increase public awareness.

This document intends to…

Give an overview of both the emergency services organisational structure in Italy, as well as a case study of the migration to 112 in Tuscany. It shows the benefits of transitioning to a single European emergency number in terms of both an effective response as well as public awareness.

This document intends to…

- Explain the emergency services organisation structure in Italy
- Explain the transition process from the old emergency numbering system to 112 in Tuscany
- Demonstrate the call system management in the pre-hospital service
- Formally note the migration process implemented by stage 1 PSAPs in Tuscany
- Show the positive outcomes of a single emergency number (112)

1. Emergency Services Organisation in Italy

Italy is a country of approximately 60 million citizens, with a robust regional government model. Several topics are defined on a regional level, including education and healthcare (all levels, from hospitals to family doctors, to Emergency Departments (ED) and ambulance Public Safety Answering Points (PSAPs)). There are currently 12 Regions that have replaced the emergency numbers with the single number 112 and other 8 will comply in the near future (Figure 1).

Figure 1 – Updated map of 112 diffusion in Italy

In Italy, there are four main emergency numbers:

- 112 is used historically by the national military police of Italy called Carabinieri, policing both military and civilian populations. In addition, there are hundreds of PSAPs on the territory, managing the traditional Carabinieri emergency number.

Under the Ministry of Defence, Carabinieri is a national agency managed at a national level.

- 113 has been used by the National Police since 1968. The "Questura", equivalent of a provincial Police headquarters, manages the service. There are currently 103 Questuras (PSAPs) managing the Police emergency number. The police are a national agency under the Ministry of Interior (MoI), managed at a national level.
- 115 has been used by the Firefighters since 1987. The Firefighters' Provincial headquarters manage the service. There are currently 100 provincial PSAPs managing the Fire emergency number. Firefighters are a national force under the Ministry of Interior, managed at a national level (except for four tax-independent regions).
- 118 has been used by the Prehospital Emergency Medical Service since 1992. Each province manages the service (110 provinces), with a few exceptions, such as Lombardy and five other regions where the service is managed on a regional level. Emergency Medical Services are a local responsibility, receiving directives from the Ministry of Health.

This heterogeneous conformation of responsibilities raised some problems when deciding to implement a single Emergency Number, namely 112: the coordination of forces, some of which have local power to decide their processes, and others are managed at a national level, and the coordination of ministries when managing the new emergency number, mainly because the Carabinieri already used 112.

The process implemented in all 112 PSAPs in Italy is regulated by a Standard Operations Procedures (SOP) document, created jointly by the Department of Public Safety, the Department of Public Rescue and Fire Brigades belonging to the Ministry of Interior and the Arma dei Carabinieri belonging to the Ministry of Defence.

The SOP document deals with:

- Procedures for the 112 PSAP call takers;
- Mapping of all dispatching PSAPs involved in the rescues, with territorial jurisdictions and timetables of availability;
- Methods of call transfer and data transfer between the 112 PSAPs and the dispatching PSAPs including the XML data format that every software vendor involved with emergency services PSAPs or 112 PSAPs must implement to enable the data transfer;
- Handling of calls in a foreign language;
- Handling of technical issues (redundancies, disaster recoveries, etc.).
- Responsibilities for the maintenance of the 112 system.

In particular, it is worth noticing how the SOP document describes the call takers as employees "Appointed of Public Trust", whose duties and rights are described in Art. 1 of Law no. 146, of June 12, 1990: the call takers, being Public Trust employees, have a role that is created for the benefit and the interests of the community. This role bypasses the nature of their employment for regulation matters, and the rules for Public Trust Agents are applied to their contracts. In addition, it is important to note that the SOP document specifies that 112 PSAPs manage incoming emergency calls, filter false calls and forward real emergency calls and related data to the correct dispatching PSAP. The 112 PSAP, therefore, has no formal management function over the emergency operations (e.g., dispatching).

In this context, it is interesting to read data about the awareness of the single number that gives us a measure on how it is used and how well it is known both among the European population and in Italy.

The use of the numbering (old numbering versus the unique emergency number 112) is monitored all around Europe through an annual report. The 2022 Report on the implementation of 112 the European Union emergency number states that in 2021 calls to 112 increased by 3% to 153 million compared to 2019. Meanwhile, the total number of emergency calls (including to the national emergency numbers where these are still in use), remained steady at 270 million. Calls to '112' represented 56% of all emergency calls in Europe in 2021, in Italy the awareness given from the report above shows a significative increase (19% in 2020 to 89% in 2021).

1.1 Emergency calls handling model in the Italian Regions that have made the transition to 112

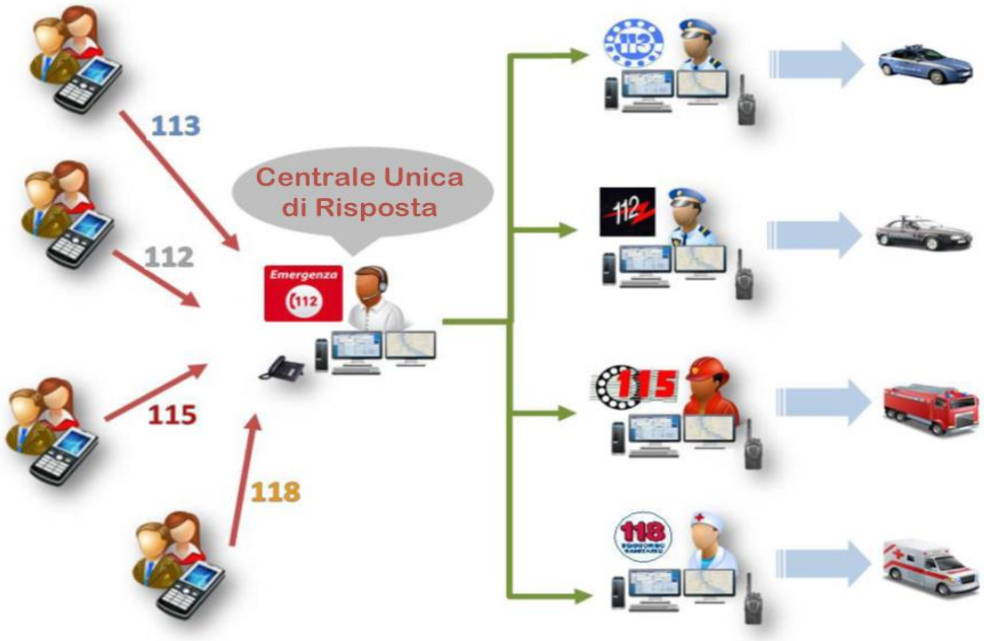
The emergency call is managed at two levels: the PSAP1 receives the call and forwards it, after locating the caller, to the PSAP2, i.e., State Police (113), the Carabinieri (112), the Firefighters (115) and the Prehospital Emergency Medical Service (118) who actually manage the emergency situation dispatching the call.

Whatever national emergency number you call (113, 112, 115 and 118), the call is received by the 112 PSAP1.

When the PSAP1 operator answers the call, he receives the telephone number and location of the caller in real time, which are automatically entered in a digital format card (contact card).

The form is then integrated with information on the type of assistance required and transferred, together with the call, to the appropriate PSAP2 that is responsible for the intervention (Figure 2).

Figure 2 – The path of the emergency call



1.2 Call Geolocation

The traditional caller location is done using the service provided by the MoI through its data centre, connected to the telecommunication providers. By law, telecommunication providers are obliged to provide the location of their subscribers to the MoI. Landline subscribers are located using the Provider's database, and mobile subscribers by cell triangulation. In both cases, the 112 PSAPs receive this location by requesting it to the MoI central geolocation data centre using the Calling Line Identifier (CLI) and the OP-ID3 (telecommunication provider identifier). The location information is retrieved in approximately 2-3 seconds and displayed directly in the 112 CAD software. This technology was activated in 2011 in the first pilot 112 PSAP in Varese and is currently available in all other 112 PSAPs in Italy. In time, it was empowered by different geolocation methods as eCall and the smartphone app "Where Are U" that give much more precise geolocation data than the regular MNO cell triangulation information, allowing more accurate results especially in rural areas. Finally, there is Advanced Mobile Location (AML).

The AML system was born in 2016 in the United Kingdom, it is an automatic procedure for the precise localisation of the mobile terminal in the event of a 112 call. As soon as the emergency call is activated, the device from which the call is made determines its position using several technologies in parallel by activating GNSS and WIFI; so, during the call without any other action by the caller, the position acquired by the mobile receiver is automatically sent to the reference PSAP1. Since the beginning of 2022, thanks to updates done by IOS and Android, the 112 PSAP1s all over the national territory benefit from this localisation data in 70-80% of cases. The transmission of the data by the AML system takes a few seconds to be processed and received by the 112 (<30 sec), appearing to the PSAP1 operator during the telephone interview. The operator then has the task to verify the accuracy of the location, considering the most reliable data among those available and it is forwarded to the appropriate PSAP2. All over the nation is taking place an implementation of the transmission form used by the 112 PSAP1 towards PSAP2. The AML position acquisition modality will be enhanced in the new form and the different localization modalities that have been put in place with the relative position coordinates will be visible to the PSAP2 operator.

1.3 Dispatching of the Emergency Call

The duty of the 112 call-taker ends when:

- The emergency call is forwarded successfully to a dispatcher (PSAP2)

- The incident form created on the CAD software by the call-taker is successfully forwarded to the same dispatcher. The integration developed on the 112 PSAP CAD software allows the call-taker to know if the data is received and read by the dispatcher on his screen. Once these two actions are performed, the call-taker can close the incident and archive it (at 112 PSAP1 level).

From now on, the emergency is the responsibility of the dispatcher, who has to confirm with the citizen the data received from the call-taker (location of the call and general reason for the emergency) and continue the interview, to get a detailed description of the event, in order to create the most appropriate dispatch.

2. Transition process from the old emergency numbering to 112 in Tuscany

Given the fragmentation of the Italian emergency call management system, which is sometimes widely differentiated even within the same region, the unification of the emergency number has led to enormous changes in terms of structure, strategy, and technology. Italy started with Lombardy to set up the first PSAP1 112 in 2010, Tuscany locates itself halfway in the European project for the transition to a single numbering system for emergencies. The activation process of 112 in Tuscany takes place formally with the DRGT 303 of 03/27/2017 and ends with the launch of the activity of the Tuscan PSAP1 on 10 December 2020. The Tuscan PSAP1 is the largest in Italy and started the activity for the provinces of Florence and Prato. The extension of coverage to the remaining Tuscan provinces (Arezzo, Pistoia, Lucca, Massa Carrara, Siena, Grosseto, Pisa and Livorno) took place gradually over 2021 and was preceded by a substantial remodelling of the PEMS PSAPs 2 in the whole region.

3. Call system management in the pre-hospital service

3.1 The pre-hospital emergency medicine PSAP2

For a correct and complete analysis of the health emergency management system in Tuscany, it is necessary to report some structural data. In Tuscany there are 6 PSAPs2 for the management of calls relating to the health emergency covering 3.692.865 inhabitants which is equivalent to 6.2% of the Italian population. The region counts for 162 residents per square km compared to 189 on average nationwide. This information was obtained by combining high-density areas (Florence metropolitan area) with large sparsely populated areas (southern Tuscany), ranging from the region's 361 flat areas (8.4%) to the region's 87 mountainous areas (25.1% of the total surface area).

Towns in Tuscany are small: of the total 287, 236 have at least 15.000 residents, and of these, 140 have less than five thousand. 51% of residents live in communities with fewer than 30.000 people.

The dynamics of the most recent decade have seen a migration flow from the largest urban agglomerations to the smallest rural communities.

Ageing is a peculiar characteristic of the Italian population, particularly that of Tuscany. The second-oldest area after Liguria is Tuscany, which has a population that is relatively more ancient than the rest of Italy. The median age of Friuli is 45 years old, which is just slightly older than the national average of 44 years old (48 years in Liguria 47 years in Tuscany). Despite Tuscany low rate of population growth, the region's percentage of children aged 0 to 14 is among the lowest in Europe with 11,7% (Italy 14,4%), compared to a median of 25 countries' 17,1%. Hence, Tuscany has to produce close to 200.000 children to reach the European average. In the ten years between 1991 and 2001 population census, Tuscany lost 32.000 residents, or 1% of its population. To date, it can be determined how quickly the ageing process has progressed despite the fact that

the loss has not been seen with great intensity in its composition. In fact, there have been 180.000 losses among children and young adults under the age of 25 and 96.000 incremented units of 65 years and over. We now have nearly 2 elderly people for 1 child, with the old-age index rising from 158% to 192%.

The population in working age has decreased by 101.000 units (-4%), and it has increased as a result of the 153.000 unit (-6%) decline in the number of children between the ages of 15 and 24.

All the PEMS PSAPs2 refer to three companies that operate according to the following territorial jurisdiction:

- North-West Tuscany Local Health Agency has two PEMS PSAPs2 covering 1.253.959 inhabitants;

1. PEMS PSAP 2 Alta Toscana which covers the provinces of Lucca and Massa Carrara;
2. PEMS PSAP 2 Livorno and Pisa which covers these two provinces except the municipalities of Castelfranco di Sotto, Montopoli in Val D'Arno, San Miniato and Santa Croce sull'Arno;

- Central Tuscany Local Health Agency that has two PEMS PSAPs2 covering 1.620.758 inhabitants;

1. PEMS PSAP2 Pistoia and Empoli which covers the province of Pistoia and the municipalities of Capraia and Limite, Cerreto Guidi, Certaldo, Castelfiorentino, Empoli, Fucecchio, Gambassi Terme, Montaione, Montelupo Fiorentino, Montespertoli, Vinci, Castelfranco di Sotto, Montopoli in Val D'Arno, San Miniato and Santa Croce sull'Arno;
2. PEMS PSAP2 Florence and Prato which covers the province of Florence (excluding the Municipalities of Capraia and Limite, Cerreto Guidi, Certaldo, Castelfiorentino, Empoli, Fucecchio, Gambassi Terme, Montaione, Montelupo Fiorentino, Montespertoli, Vinci) and the province of Prato.

- South-East Tuscany Local Health Agency that has two PEMS PSAPs2 covering 818.148 inhabitants;

1. PEMS PSAP2 Arezzo which covers the province of Arezzo
2. PEMS PSAP2 Siena and Grosseto which covers the provinces of Siena and Grosseto
3. The PEMS PSAP2 Florence and Prato is the one that manages the highest number of emergency calls among the whole region with 135.757 calls received during the year 2021.

3.2 Organisation

PEMS PSAPs2 have the task of managing the entire territorial network of health emergencies and urgencies, including the transport of organs, the transfer of patients between hospitals and other services and activities connected to medical assistance. While inside the regional PSAP1 works almost exclusively technical personnel, the PEMS PSAPs2 are managed by healthcare professionals mainly nurses, but also doctors and technical personnel. One of the outstanding features of PEMS in Tuscany is the high reliance on operational resources provided by volunteer organizations. Tuscany has always been able to rely on an unimaginable resource of community participation when assistance is needed. This is due to the region's unique commitment to solidarity, which sets it apart from the rest of the world for having the oldest tradition of aiding, originating with the first patient transportation in the XIII century.

3.2.1 Call taking and emergency management

The emergency call is passed to the PEMS PSAP2 through the computer system with voice accompaniment; the location procedure of the event has already been carried out by the 112 technical operator and the nurse at the receiving station of the PSAP2 of the health emergency only needs to make a confirmation, followed by the assessment of the seriousness of the event and the dispatch of the most appropriate means of rescue. The assessment of the severity of the event is performed via the 'Dispatch System'.

3.3 The 'Dispatch System'

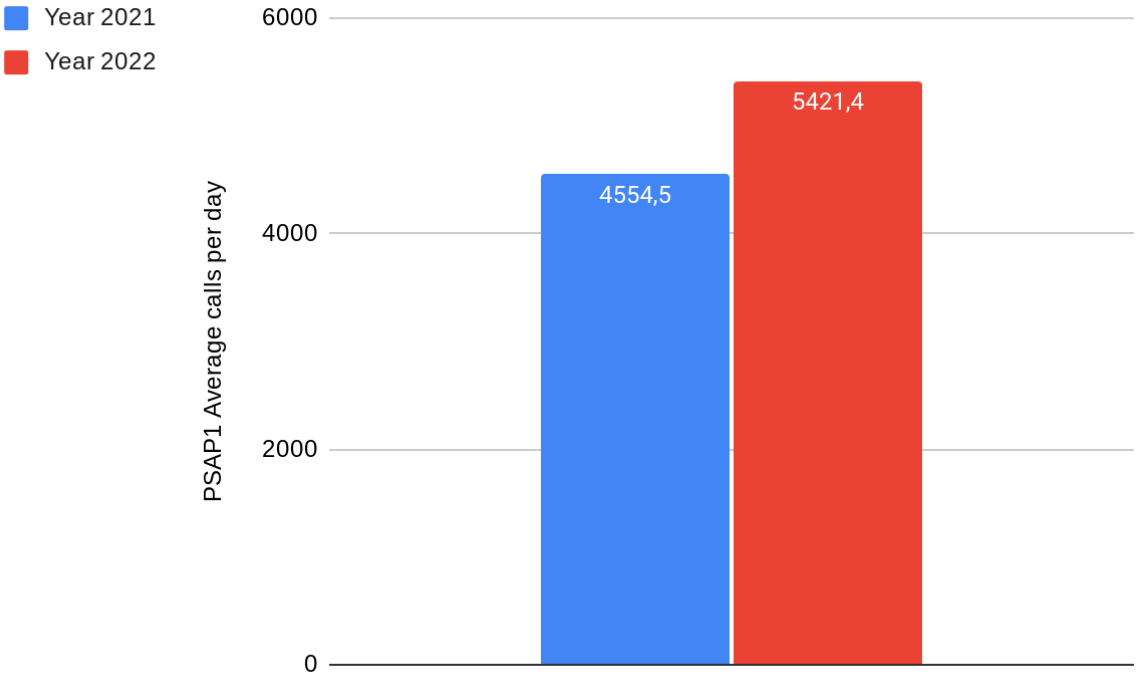
The Dispatch System was introduced in order to unify and make universal the processes of evaluation and definition of emergency interventions implemented by the PEMS PSAPs2 in Italy. It is a methodological tool useful to establish the correct attribution of location, patient classification, evaluation of the severity and finally the need to deploy and involve contingent resources, including non-medical ones (such as Police and Firefighters). This is a guide for the reception and management of telephone requests for medical assistance, which aims to optimize the telephone interview and obtain the correct assessment of the degree of complexity of the intervention in order to ensure the activation of the most suitable means and crews for individual needs. This method in the hands of the health care professionals is an effective tool in establishing the severity of the rescue request and consequentially the most appropriate crew to send. The vehicles that can be activated have on board crews with different levels of assistance capability: first-aid ambulances that can perform basic life support and guarantee the use of the automatic defibrillator (BLSD) called BRAVO, ambulances with a nurse on board called INDIA, ambulances with a doctor on board called MIKE, cars with a doctor and nurse on board called ALFA and the helicopter PEGASO. The need to make universal use of an effective system based on patient assessment processes is justified by the need to rationalize intervention. The efficiency of this system has always been identified in the triage system, which is exclusive prerogative of healthcare professionals, although it is interpreted differently depending on the operational contexts in which it is implemented and depending on the regions that have defined it.

4. The process implemented by 112 PSAP 1 in Tuscany

4.1 Analysis of the Activity of the 112 PSAP 1

From the beginning of the activity on December 10th 2020 since December 31st 2022 the Tuscan PSAP1 has managed 4.063.478 calls. The average per day is shown in Table 1.

Table 1 - Average calls per day managed by the Tuscan PSAP1 during the year 2021 and 2022



As it can be noticed the activity increased of 19% due to the progressive extension of the coverage to the whole region as described above. Tuscan PSAP1 staff is able to answer the caller in an average time of around 3 seconds (Table 2) to localize and forward the call to the PEMS PSAP2 in an average time of 15 seconds (Table 3).

Table 2 - Average response time by the Tuscan PSAP1 staff during the two years of activity

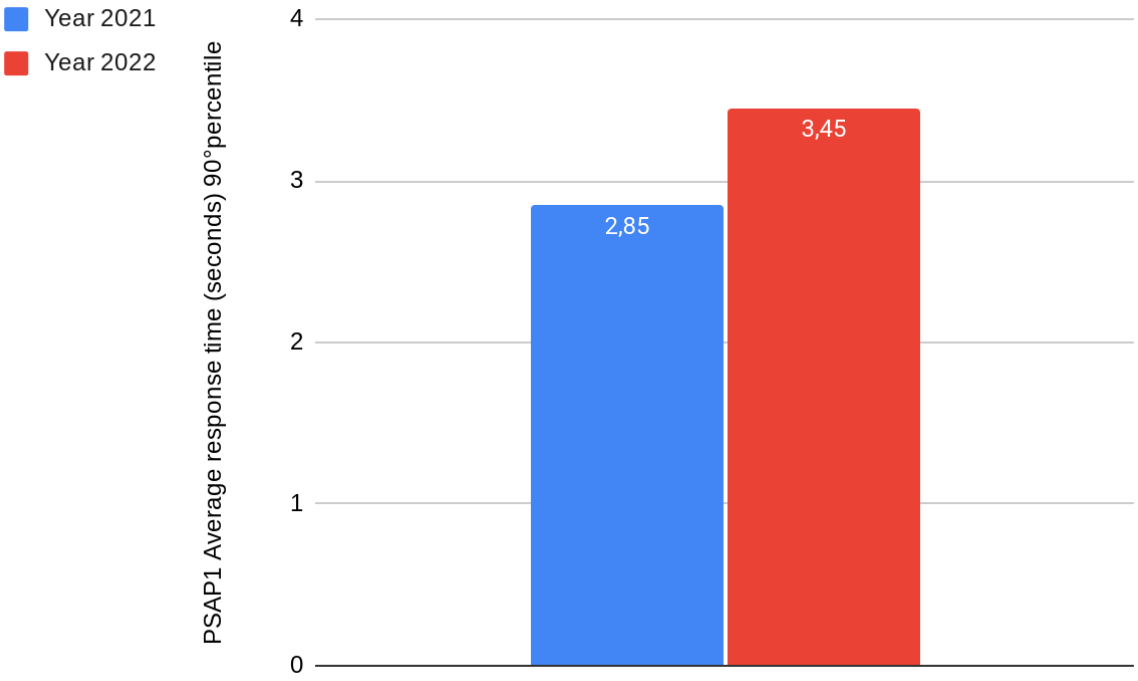
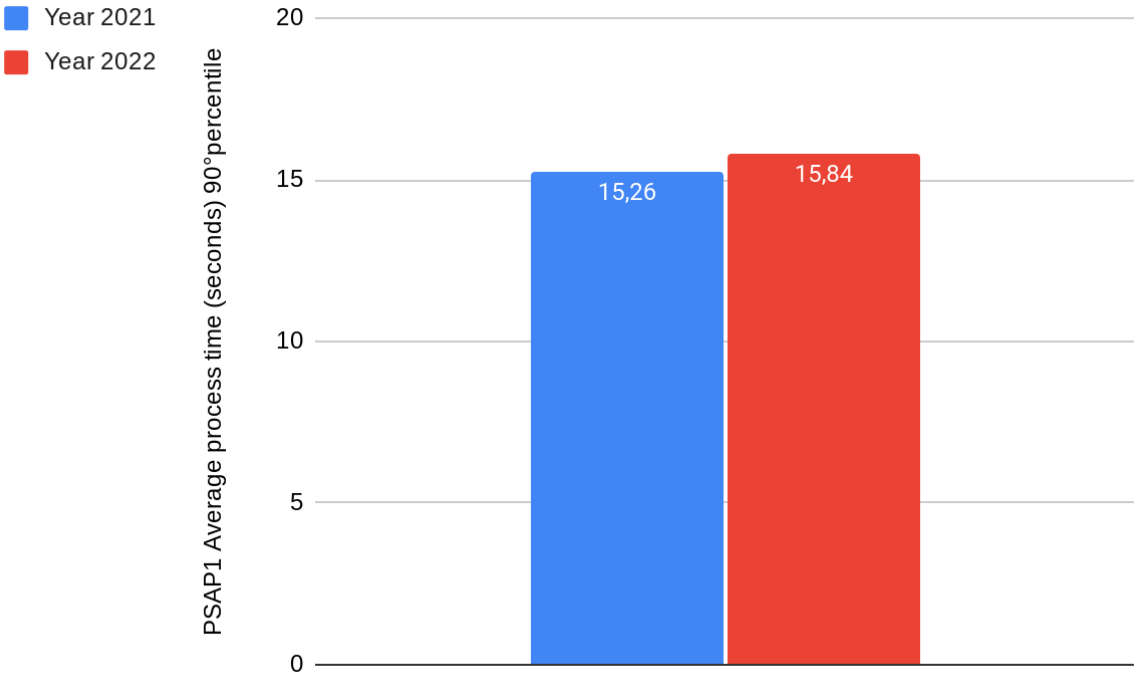


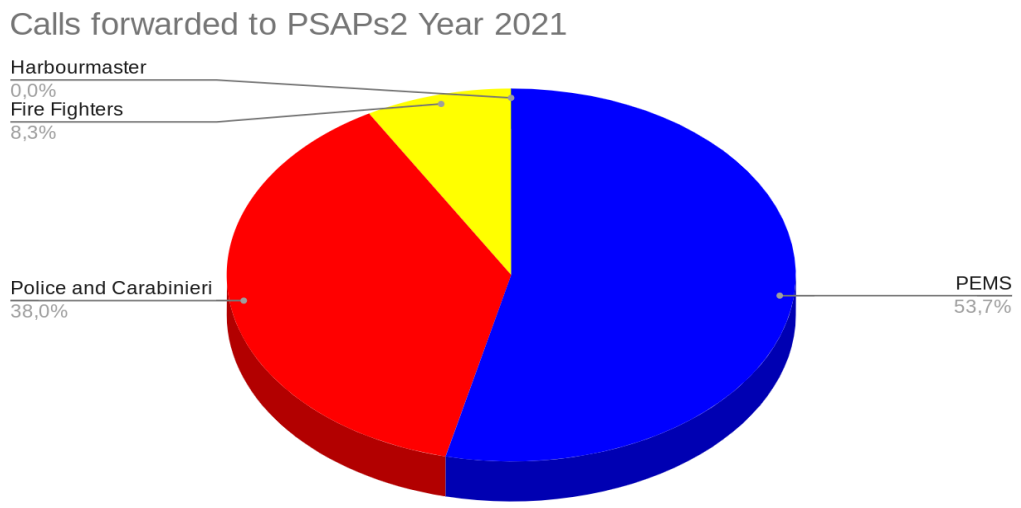
Table 3 - PSAP1 Average process time is the time spent by the Tuscan PSAP1 staff forwarding the call to the PEMS PSAP2



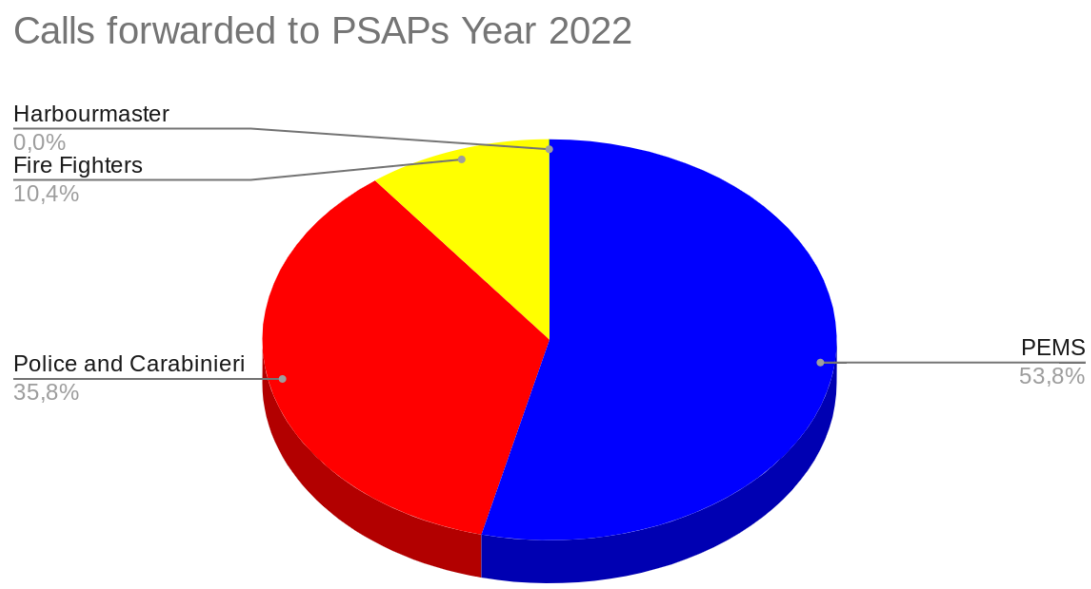
As happened in other regions one of the main concerns was that adding a PSAP1 is equivalent to add an extra step to the emergency call, which results in a waste of time making the system less efficient and potentially dangerous for citizens, especially for medical emergencies.

This statement turned out not to be true even in Tuscany where the PSAP1 gave proof of efficiency in filtering and forwarding to the correct PSAP2 only real emergency calls, cleaning them from everything that was not an emergency such as prank calls, unappropriated calls, requests for information etc. Graphs 1 and 2 show the % of emergency calls forwarded to the PSAPs2 with more than half of the calls forwarded to PEMS followed by the security forces, than by Firefighters and the Harbormaster that accounts only the 0.03% both in 2021 and 2022 of the emergency calls managed and forwarded by the Tuscan PSAP1.

Graph 1

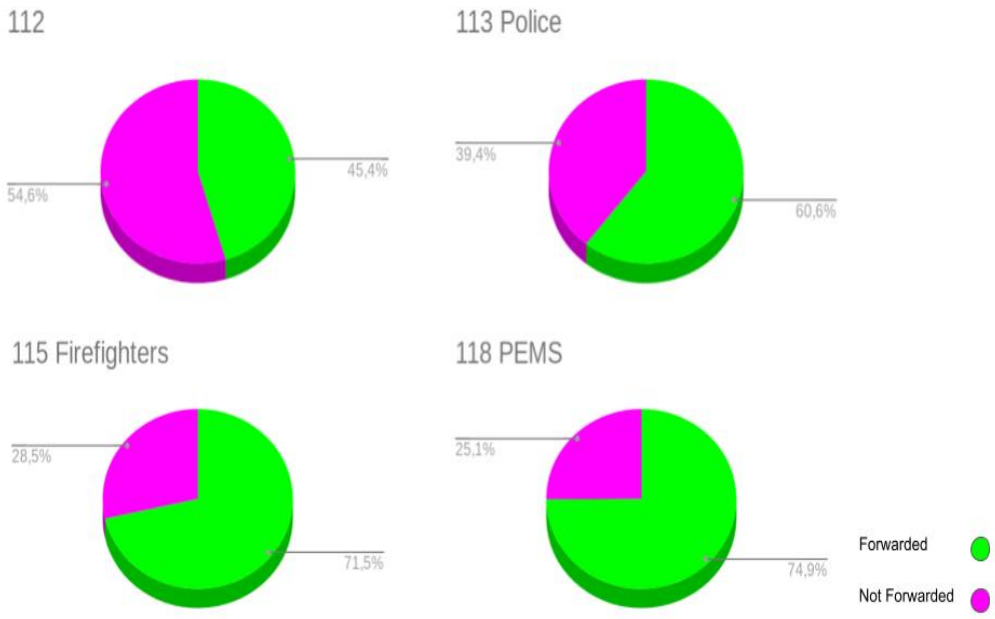


Graph 2

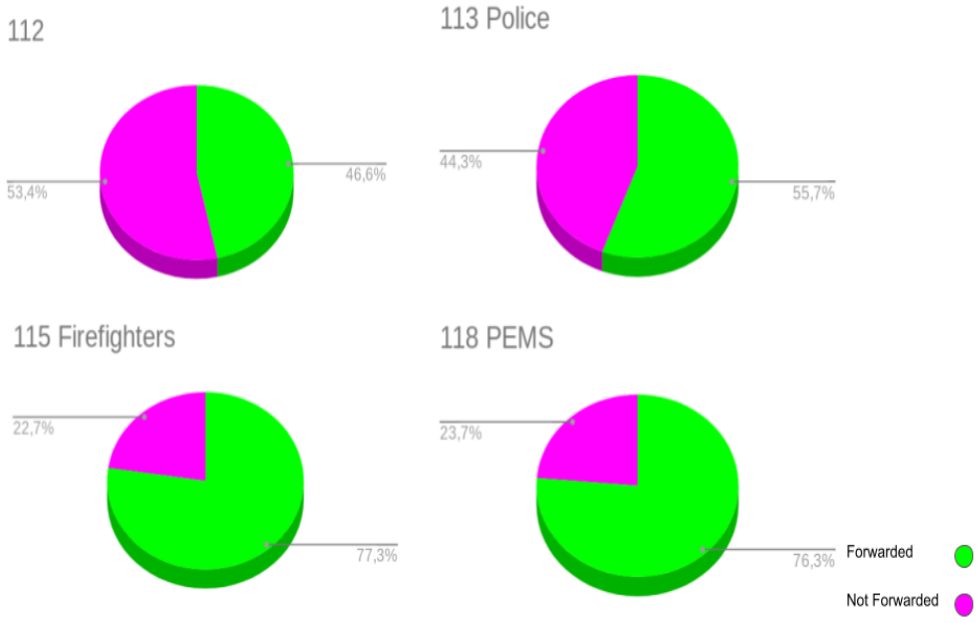


Dealing with the filter action performance of the Tuscan PSAP1 in Graphs 3 and 4 are the percentage of calls forwarded to each PSAP2 and the calls that end in PSAP1 divided by year.

Graph 3 - Percentage of calls forwarded to each PSAP2 and the calls that end in PSAP1 during 2021



Graph 4 - Percentage of calls forwarded to each PSAP2 and percentage of calls that end in PSAP 1 during 2022

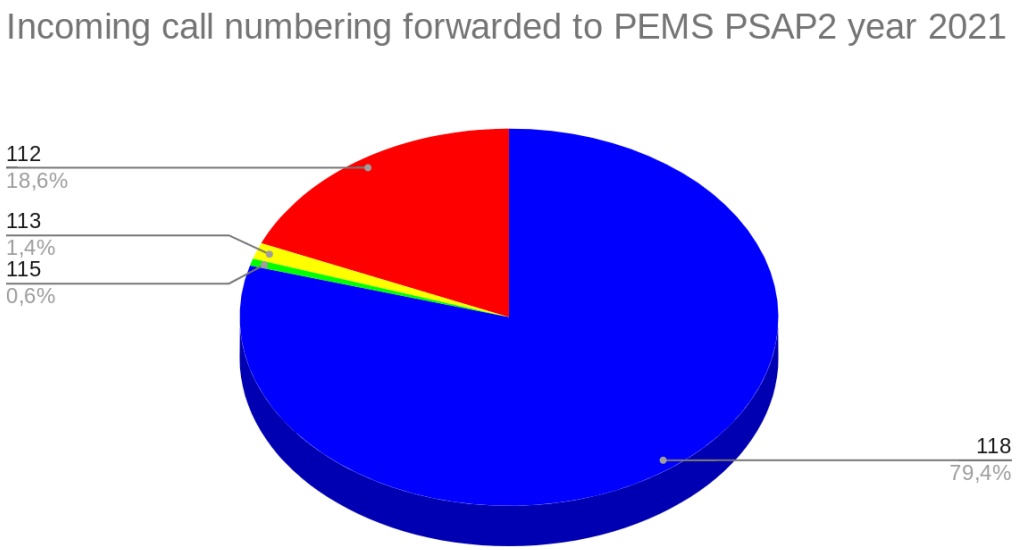


About 1/3 of the calls do not reach the PSAPs2 to which only real rescue requests arrive reducing their workloads.

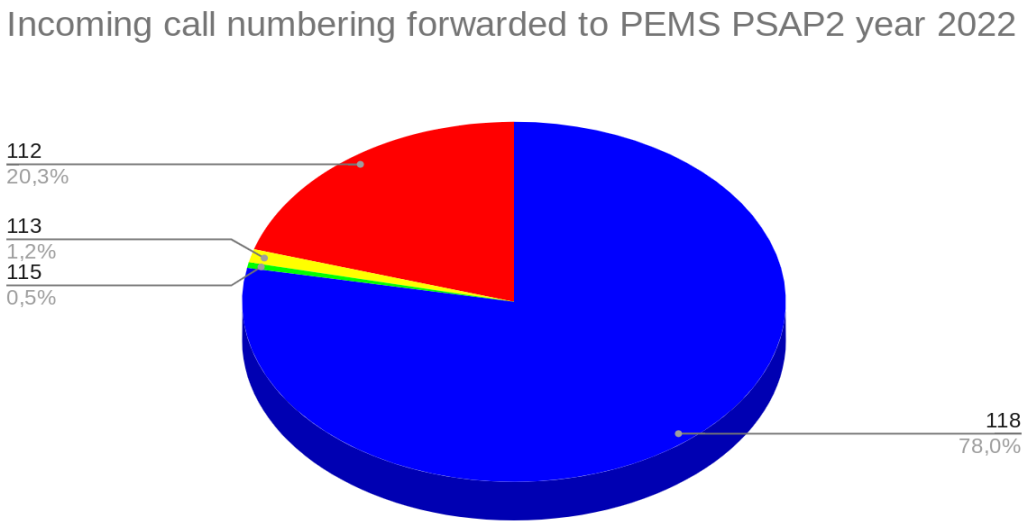
All emergency numbers still exist: 112 PSAP can determine which number was dialled and can understand if the citizen dialled the correct number for his type of emergency or if they made a mistake.

In that case, the call-taker can redirect the call to the proper dispatcher, avoiding a misrouting of the call, which could land on the wrong type of emergency service, without a first level 112 PSAP. Regarding the calls directed to PEMS in Graphs 5 and 6 is represented the incoming number dialled to activate PEMS during the year 2021 and 2022.

Graph 5 - Incoming call numbering forwarded to PEMS in 2021



Graph 6 - Incoming call numbering forwarded to PEMS in 2022



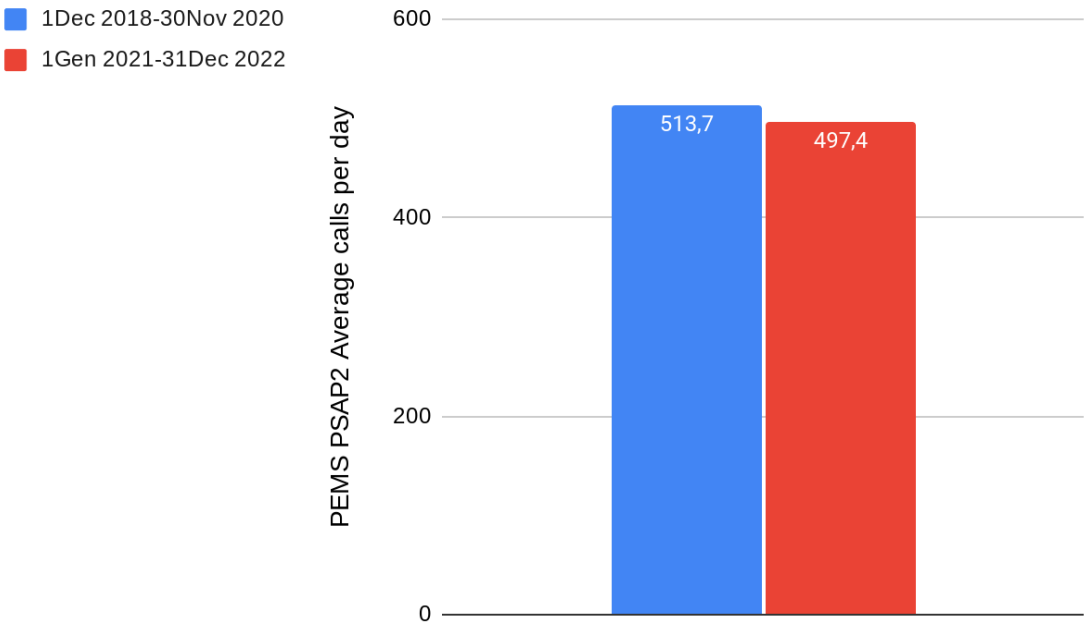
Still more than 1/3 of the Tuscan population uses old numbering to activate PEMS even if there is a 9.14% increase in awareness in 2022 with a 20.3% of people that dials 112 to Activate PEMS vs 18.6% of 2021 and this is in line with the literature on this topic.

4.2 Call management quality by the Pre-hospital Emergency Medicine PSAP2 before and after the introduction of 112

As explained in paragraph 3.1 the PEMS PSAP2 Florence and Prato is the one that manages the highest number of emergency calls among the whole region with 135.757 calls received during the year 2021. The provinces of Florence and Prato cover an area of 3144 square kilometres and have a resident population of 1.089.734, with an average density of 347 inhabitants/square kilometre. To better understand how the introduction of the PSAP1 influenced the activity of the PEMS PSAP2 of Florence and Prato two two-year periods were analysed: the first from 1 November 2018 to 30 November 2020 before the beginning of the activity of the Tuscan PSAP1, the second from 1 January 2021 to 31 December 2022 after the beginning of the activity of the Tuscan PSAP1.

Comparing the two periods under analysis the average number of calls per day shows a decrease of - 3,11%.

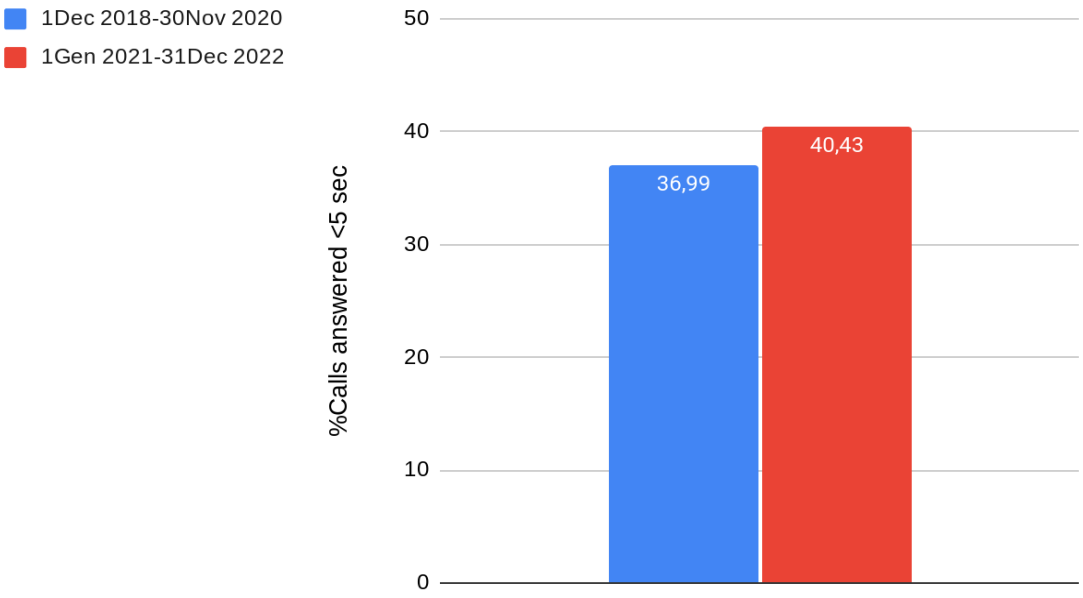
Table 3 - PEMS PSAP2 average calls per day



This data should be read in the context of a progressive increase in the number of calls to the PEMS PSAPs2 throughout Italy, which has been around +10% per year also due to the pandemic. Thanks to the good filter action performed by the Tuscan PSAP1.

In terms of performance of the PEMS PSAP2 the % of calls answered within 5 seconds in the two periods analysed are shown in Table 4.

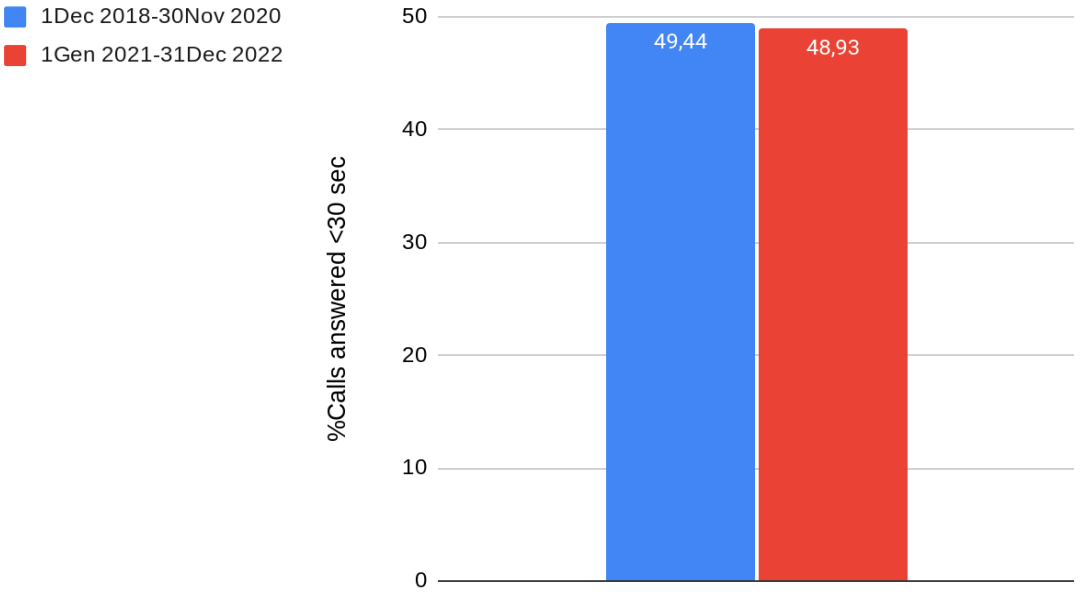
Table 4 - Percentage of calls answered within 5 seconds by the PEMS PSAP2 Florence and Prato



There is a +8,98 % of calls answered in less than 5 seconds which is statistically significant (p<0,05).

Table 5 shows the % of calls answered within 30 seconds and there are no significant differences between the two periods.

Table 5 - Percentage of calls answered within 30 seconds by the PEMS PSAP2 Florence and Prato



Statistically significant is also the reduction in unanswered calls (-60,3%) and abandoned calls (-77,6%) in the two periods compared (p<0,05) Table 6 and 7.

Table 6 - Percentage of calls unanswered by the PEMS PSAP2 Florence and Prato

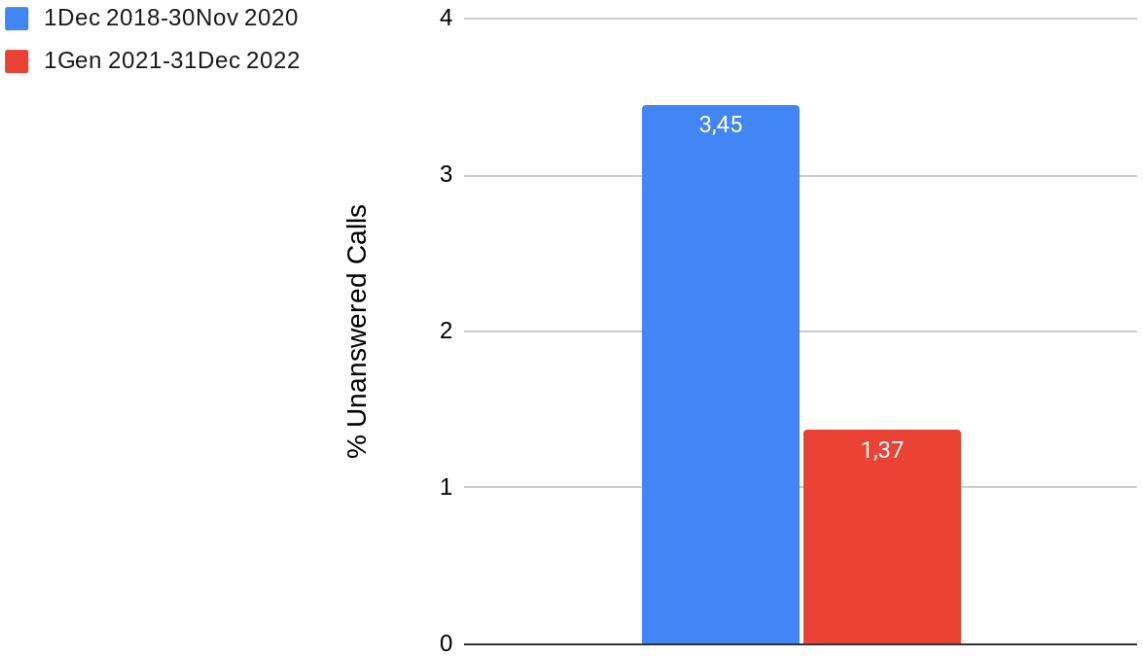
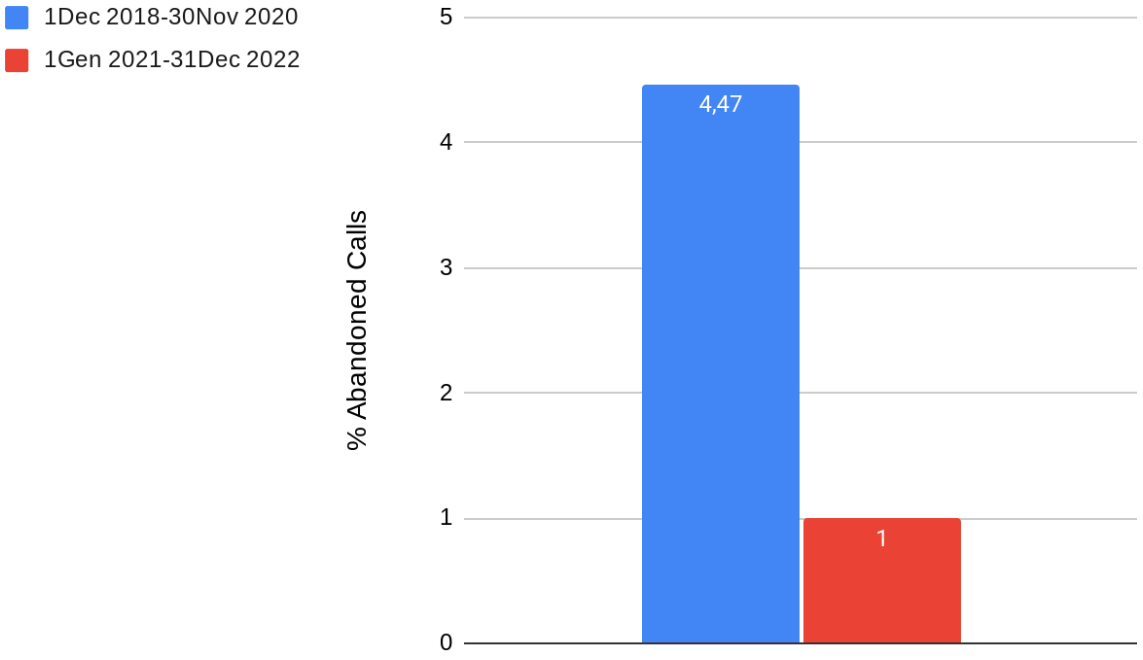


Table 7 - Percentage of calls abandoned by the PEMS PSAP2 Florence and Prato



The introduction of the Tuscan PSAP1 improved the performance of the PEMS PSAP2 due to its excellent filtering and localization action. The PEMS PSAP2 is only reached by real distress calls so the health care professionals are allowed to concentrate the activity on the management of real emergencies.

5. Discussion and Conclusions

As happened in Lombardy, the process of reorganisation of the healthcare system in Tuscany is involving sectors other than the emergency healthcare, and after the success of the 112 PSAP1, we are getting ready for the arrival of a new single number 116117, which will manage everything that is not an emergency. A significant change will be made to the Italian national healthcare system's conception of non-emergency services and treatment, giving regional/provincial entities outside of hospitals more "authority" to offer diagnostic, therapies, and care. These structures will also serve as barriers to hospital access. Hospitals will develop into centres for highly specialised medical care, with territorial structures absorbing as much of the demand for non-hospital healthcare as they can. In comparison to the rest of Italy, Tuscany has a somewhat older population, and this is a key fact (as explained in paragraph 3.2). Many changes in the Tuscan region's emergency system are directly related to the features of its population. The decision to shift the emphasis of non-emergency care into new or alternative structures will have substantial ramifications and effects on the distribution of resources and the organisation of service delivery to residents. The implementation of these reforms will take some time, especially in Italy where the healthcare system is extremely complex. For this reason, without a plan of action to respond to requests for non-urgent intervention, the Tuscan regional healthcare system continues to be mostly characterised by the presence of a higher concentration of physicians and nurses than the average national level. The process of transitioning in progress, from a strongly medicalized strategy of intervention and treatment on the site “stay and play” to one of hospitalizing purpose only “scoop and run”, must be supported by a homogeneous structure of taking in charge of emergency requests with intermediate actions of evaluation and response up until the stage of telephone request collection.

Nonetheless, the technological infrastructure's modernization and, consequently, the strategic asset of the medical emergency cannot ignore the characteristics of the users who request for assistance: a population that is very resistant to technological changes and is by definition sedentary, making it difficult for them to fully adapt to new ideas. An ongoing process of resource reorganization throughout the area is based on a revised legal framework that uses the most up to-date international approaches to managing territorial emergent situations as a model. In this case, the competency is being gradually transferred from medical management of emergencies to emergency nursing.

As is the case in other European countries where the role of the emergency nurse has been a topic of discussion for many years, this results in an expansion of the skills, operational responsibilities, and scope of the nurse's intervention. As a result of a future, complete national reform of the emergency system, it is essential to plan for a future advancement of the medical professionals' clinical skills.

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