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## Prison break: Remote tele-cardiology support for cardiology emergency in Italian penitentiaries

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The delivery of high quality health care assistance may be not easy with prison detainees. Prison inmates may need outdoor referral, particularly in case of suspected acute coronary syndrome or arrhythmias and in small penitentiaries without adequate infirmaries; outdoor referral may often lead to waste of time, surveillance personnel, and money.

According to a survey on quality of health care in British prisons, a few of these provide health care broadly equivalent to national health care service; in many the health care is of low quality and little professional support is available to healthcare staff [1].

The only way to get a cardiologist needed in every prison, since getting the detainee out of prison usually needs escorts and supervising board authorizations, is often tele-medicine support.

Tele-medicine is presently applied in several fields of medicine [2–11]; tele-cardiology was shown useful in the management of acute coronary syndrome [12,13], atrial fibrillation [14], and syncope [15] and even in implementing strategies of cardiovascular primary care [16]. Tele-medicine support allows a trained nurse to deliver ultra-specialist medical acts with the remote support of qualified professionals such as a cardiologist [17].

We therefore aimed to report on the feasibility and preliminary findings of a pilot experience of remote tele-cardiology support for cardiology emergency in 12 Italian penitentiaries.

Twelve State penitentiaries situated across Apulia (Fig. 1), a region in South-Eastern Italy, were involved in the project, which was supported by Apulia Supervising Authority on Penitentiaries, and provided with a pocket ECG recorder (CardioVox P12, Aerotel, Holon, Israel).

Prison nurses followed a short training aimed at the acquisition of skills required for ECG recording and transmission. The ECGs were recorded in any case of chest pain, palpitations, dizziness/syncope, dyspnea or suspected acute heart disease.

The ECGs were sent by telephone connection to a regional tele-cardiology “hub”, serving the entire region of Apulia, located in Bari, capital city of Apulia, where a cardiologist available 24/7 promptly read the ECGs and gave a brief consultation. ECGs were immediately sent back via the internet, fax or visualized back on smart-phones. Tele-medicine support was provided by Cardio-on-Line Europe s.r.l. (Bari, Italy) as previously described elsewhere [18]; the tele-cardiology hub also supports the local emergency medical service 118 Apulia.

The study was authorized by local Supervisory Correctional Authorities.

Two thousand and fifteen ECGs were recorded and sent to tele-cardiology hub from January 2010 to February 2013 (Fig. 2).

Only 5 subjects screened by pre-hospital tele-cardiology ECG were female; 83% were smokers, 42% hypertensive, 7% diabetic, and 51% had history of any heart disease.

Forty percent of ECGs were recorded because of acute chest pain suspected for myocardial infarction, 4% because of dizziness/syncope, and 0.3% for palpitations.

ECGs showed normal findings not requiring urgent hospitalization in 62%, minor findings not requiring urgent hospitalization in 34% (premature contraction, sinus tachycardia or bradycardia, permanent atrial fibrillation) and abnormal findings requiring further clinical examination out of prison in only 4% (ventricular tachycardia, ischemic ECG anomalies).

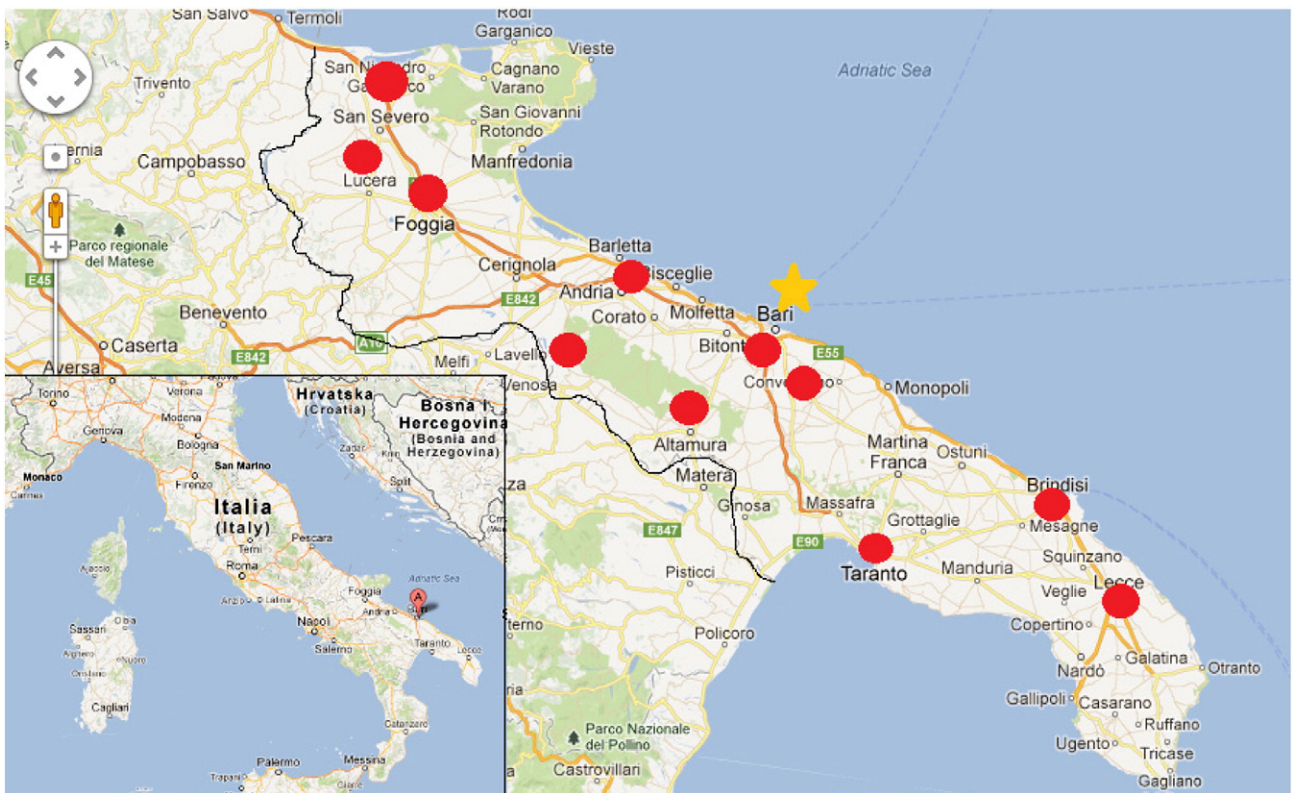
We showed in this report the feasibility and preliminary findings of a pilot experience of remote tele-cardiology support for cardiology emergencies in a dozen of Italian penitentiaries. To the best of our knowledge, this is among the first studies reporting on possible use of tele-cardiology for the prompt diagnosis of acute myocardial infarction or severe arrhythmias in prison detainees.

The delivery of effective health care to prisoners is dependent upon partnership between health and prison services and telemedicine which is one possible mode of delivery [19]. Several prior studies investigated possible benefits of tele-medicine in prison contexts, although a few studies have indicated that in specific instances telemedicine has improved access to care, referrals, contact between providers, and has also reduced unnecessary referrals [20].

A recent experience from Louisiana State involved more than 700 inmates, reporting high grades of patient's satisfaction [21]. Other experiences come from California, Texas [22] or other federal prisons [23].

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**Fig. 1.** Penitentiary locations across Apulia (from top to bottom: San Severo, Lucera, Foggia, Trani (male and female prisons), Spinazzola, Bari, Turi, Altamura, Brindisi, Taranto, and Lecce).

Most papers, however, reported on tele-medicine programs focused on surgery [24], ophthalmology [25] or psychiatrics [26].

Few data are available on emergency care with tele-medicine support in prison detainees [27]; in a study held in New York State penitentiaries, 81 of 126 (64%) telemedicine patients remained at the facility following consultation with the remaining 45 (36%) being transported to the emergency department. Rates of return to the emergency department within 7 days following consultation were comparable, patient acceptance and satisfaction were high.

Interesting preliminary data remarked possible cost reduction yieldable applying tele-medicine support [28,29]. A cost analysis study from Virginia State reports a cost saving with tele-cardiology of \$46 per visit in 1998. Because the vast proportion of telemedicine operating costs are fixed, increased utilization caused reduced cost per visit and resulted in a cost saving compared with providing these

services via a non-telemedicine program [30]. Cost reductions were found also in a study on tele-cardiology in prisons from Ohio [31].

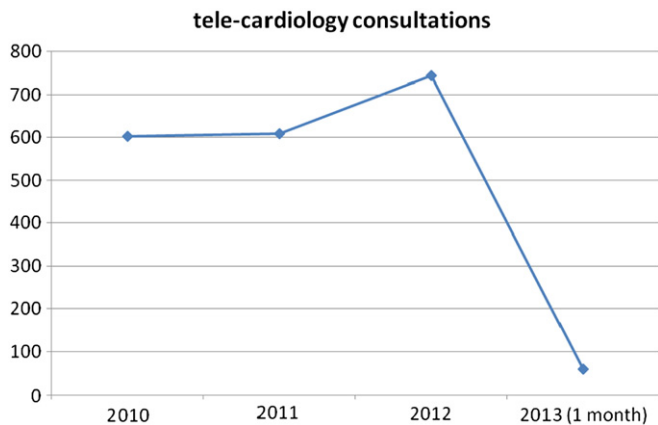
Further randomized studies, however, are needed in order to assess real clinical efficacy of tele-cardiology for the treatment of cardiologic urgencies in prison inmates; nevertheless, as remarked by Torres in a recent paper, we can agree that tele-medicine has more than a remote chance in prisons [32].

Remote tele-medicine support for cardiology urgencies with pre-hospital electrocardiogram in prison detainees is feasible. In 96% of suspected acute heart disease ECG findings were normal; in 4% an urgent hospitalization was needed.

These are preliminary non-randomized data from a small population.

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**Fig. 2.** Tele-cardiology consultation with pre-hospital electrocardiogram over years.

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## Radial approach for patients with ST-segment elevation acute coronary syndrome: It is definitely the best access site

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Transradial approach for percutaneous coronary intervention (PCI) has been widely accepted since its introduction by Kiemeneij and Laarman in 1993[1]. The advantages of this approach over the conventional transfemoral approach include reduction in vascular complications such as hematoma, pseudoaneurysm, reduction in cost of hospitalization, and improvement in quality of life[2]. In particular,

radial artery access for ST-elevation myocardial infarction (STEMI) patients has been associated with a significant reduction in mortality, potentially due to reduction in bleeding-related complications[3,4].

A meta-analysis by Mamas et al. demonstrated a significant reduction in mortality and major access site complications but no significant difference in the major bleeding events in patients admitted with STEMI treated via transradial access compared to the patients treated via transfemoral approach [5]. Conversely, another meta-analysis by Jang et al. showed that transradial PCI significantly improves clinical outcomes and reduces the risk of periprocedural bleeding[6]. However, the reduction in major bleeding events in radial approach group was only observed in the non-randomized studies in this meta-analysis.

Recently, the RIFLE-STEACS (radial versus femoral randomized investigation in ST-Elevation Acute Coronary Syndrome) study was published[3]. In this large volume randomized trial comparing radial and femoral access for patients with STEMI, radial artery access was associated with significant clinical benefits, including a lower morbidity and cardiac mortality. These findings, together with those of previous studies, drove us performing an updated meta-analysis implementing an already established methodology [5–7].

In this meta-analysis, we included 10 randomized trials involving 3978 STEMI patients[3–6]. We found not only a reduction in mortality (odds ratio [OR]: 0.55, 95% confidence interval [CI]: 0.39–0.76,  $p < 0.001$ ; Fig. 1A) and major adverse cardiac events (MACE, OR: 0.64, 95% CI: 0.48–

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