



**Hospital Waste Supervision using 4G: A Proposed Plan**

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**Abstract:** Fourth Generation (4G) mobile communication is a major buzz word these days as it claims to be providing high speed internet, higher connectivity and has increased the number of mobile subscription more than twice compared to its older generations especially in third world countries like Pakistan. Along with higher data rates and lower latency 4G often known as Long Term Evolution Advanced (LTE-Advanced) has opened numerous business cases. This research focuses on hospital waste supervision that is mostly generated from laboratories, healthcare centers, research facilities and district hospitals. Some of these wastes are reusable while other has to dispose with proper care. Sindh is one of the most hospital wastes producing province that requires a proper mechanism of disposing and reducing of hospital waster. This research focuses on utilizing of the 4Gtechnology to dispose of the proper healthcare wastes in the rural areas of the Sindh. The research suggests an automated solution for handling waste from patient bed to disposal area. It also provides a framework of intra and inter-vehicle communication and it is evident that technology can play a vital role in supervision of waste.

**Keywords:** 4G. LTE-Advanced. Healthcare waste. Hospital

**1. INTRODUCTION**

4G was officially launched in (2010) by ITU (ITU: 2010) Third Generation (3G) mostly focused on enhancing person to person communication (voice calls). It also improved the voice quality as well as introduced multimedia messaging (Karakaya, *et al.*, 2009) 4G has double and width compared to its predecessor, while data usage over mobile phone opened a new dimensions of what internet can achieve. While lower costs and higher data rate as well as lower cost of installation lead into increased infrastructure as well as coverage to newer areas (Karakaya, *et al.*, 2009) that later modified into 3GPP Long-Term Evolution (Ghosh, *et al.*, 2010) All the prominent vendors have moved to 4G or in process of transforming (Astély, *et al.*, 2009) while some other are working to move to newer generation's terms as 5G (experimental).4G is being adapted by most of prominent network providers as government opened the licenses for bidding. It promises that faster connectivity will reach at sub-urban areas while providing higher quality, higher efficiency and highly effective.

**2. INTERPRETATION OF ADVANCED LTE SYSTEM**

3GPP – LTE allows flexible radio interfacing, since the deployment of LTE in 2009, with a data rate almost 300 Mbps and latency of about 5ms. It also has increased spectral efficiency, increased number of users supported resulting in reduced cost and reduced supervision operations (Kottkamp, 2010) 4G supports multi-carrier, CDMA and OFDAM with TDMA. Only packet switching is supported that allows QoS and congestion control. (Kiiski, 2010)

**(a) Key Features of LTE-Advanced**

In downlink and uplink there is spectral efficiency for the additional development, for the users function at advantage of cell in detail (Nam, *et al.*, 2010). The next generation represents the IMT-Advanced for the wireless communications systems, the aim is to accomplish the current 3G systems and other key improvements, to reaching the (UL) uplink rate 500 Mbps and for (DL) downlink is 1Gbps (Monemian *et al.*, 2009) Currently, some of the main important aims for LTE Advanced are the peak of the data rate uplink is 500Mbps and for downlink is 1Gbps.LTE provides more than three-time efficiency of used spectrum.The spectrum used offers 15 bps/Hz for uplink and 30 bps/Hz for the downlink.The LTE is a triple user in any throughput average.The environment of mobility that is used in the LTE (Agilent, 2010).

**3. THE MISSUPERVISION OF THE HEALTHCARE WASTE**

Healthcare is a key element of society health but it does produce the waste that may pose serious health concerns to both human and environment but it is mishandled and dumped openly (Mathur *et al.*, 2012) It may result in Human immunodeficiency virus (HIV), Hepatitis B (HBV), Hepatitis C (HCV) and many other lives taking contagious disease. It is estimated by WHO annually 1.5 million HCV, 10 million HBV that may be due to hazardous injections. Arise of the toxic risk are from regents that are used in the drugs, mercury thermometers and mostly laboratory reagents. Furthermore, suitable thought the local community awareness is to dispose the proper healthcare waste

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supervision plan and to play the vital role of disposition plan. Fair regularly, the remote area healthcare services will apply the methods from urban health facilities and there waste supervision plans. Public healthcare facilities in Sindh are shown in the (Fig 1).

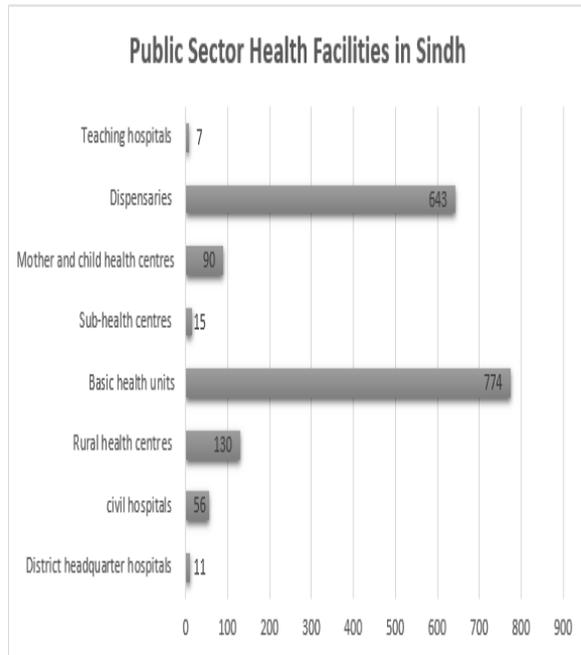


Fig 1: Public Sector Health Facilities in Sindh

#### Planning of the Managerial Function

Managerial function is process of deciding in advance that what have to perform at certain time in case of events or timeline. Zhu *et al* (2009). used the supervision of this function to manage waste. This research focuses on establishing framework that will determine the planning of the supervision purposes establishing, influencing, staffing and monitoring. In order to establish the decision making a classification of waste has to made that will be divided into two categories solid and liquid while each of them will then follow a process to get disposed as shown in (Fig 2). Healthcare focuses on environment friendly operation that yields to better community as well as healthy life being. For this environmental factor must be considered that can be internal or external as well as need well defined set of policies in each possible case as highlighted by Ahmed *et al.* (2011) In order to have a successful plan communication must be made transparent so that each decision is delivered till the workforce. Moreover the model needs a tracking and monitoring of the actions taken or performed.

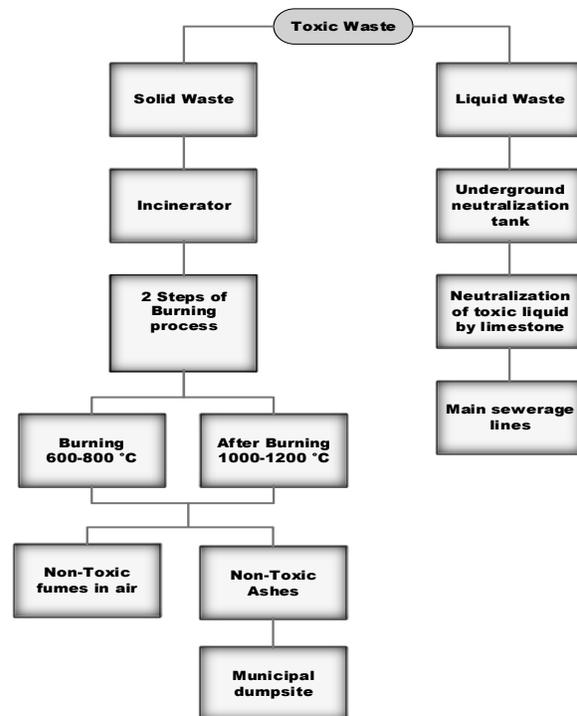


Fig 2. The selection of process and the decision making

#### 4. ISSUES IN HOSPITAL WASTE SUPERVISION

Hospitals generate hazardous waste that weight tons from individual hospital. Now issues that spin around handling the waste starts from patient whenever he is being treated to last action that is dispose of the waste.

The ideal process is as follows

- Each bed generate a waste that can classified into hazardous or general waste, this study focuses on hazardous waste. The hazardous waste is further divided into liquid and solid waste.
- Each waste is inserted into its respective bin
- The waste is being then transferred to main specially designed waste bins.
- The municipality collects the waste in special trucks and disposes it off.

But situation is not like this, where the bins are not classified, they are not closed and not cleaned off regularly generating bad smell and germs. The main hospital bin is usually located outside in an open area creating more problems. Moreover the collection truck cause the same issue where the waste is being dropped on roads, Liquids being spilled on the way and usually the liquids are drained in normal sewerage systems (Ahmed *et al.* 2011)

Planning of a safe environment: Traditionally healthcare providers give the awareness and the safety for their patients, visitors and special for the employees, and after all, several accident victims end up in hospitals and, unfortunately, some hospital deaths are caused by unsafe conditions within the healthcare facility. (Abdalla *et al.*, 2007). A patient is enabled to expect the facility of healthcare which provides the hospital staff and the staff follows the protocols which are designed by the safety department, and the patient will be reasonably safe.

e) Benefits of Planning and Implementation of the 4G Technology

In order to have successful execution of plans while making an assumption that plan made are good there is a need of system where each of the system can provide a proper feedback at each level. As success is dependent on success of small tasks, moreover distribution of tasks should be monitored too as well as the completion of task.

In order to gain the requirements hospitals across Sindh were visited where the minimum bed space was 200. Interviews from administration and nursing staff were conducted in order to understand the waste handling process as well any supervision system in effect.

4G technology is promising technology that helps MANETs in the vehicular adhoc networks (VANETs) VANET have to support the automated & intelligent transport of municipality trucks as well as intra trucks communication as shown in (Fig 3) The system should inform the drivers about environment around him like obstacles, path, and other external factors. It should also inform about collection of nearby hospital waste The System should be secure and privacy must be maintained. WiMAX and LTE-advance are part of 4G technology that can support all these requirements.

Thus the suggested process as follows

- a) Each small bin should report automatically about whenever the waste is full to waste collectors.
- b) The bins should allow only waste collection and cannot be opened excepts the hazardous waste handling big bin
- c) The Large bin should collect the waste from small bins and reseal it.
- d) The Large bin should contact the municipality staff itself whenever it is full.
- e) The municipality truck can only collect waste from the large bins.
- f) The truck can communicate with each other in order to report the task done

- g) Each task when done is automatically updated so that supervision can monitor.
- h) Continuity plan should be in action in order to handle the problems.

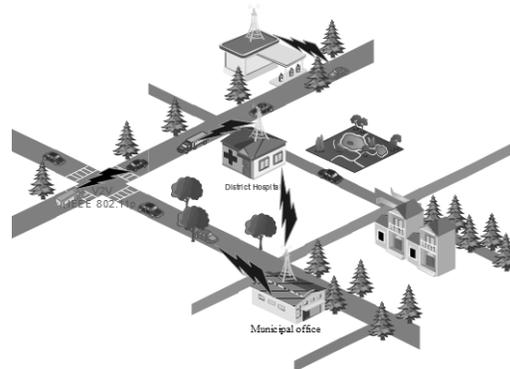


Fig 3: District Government Vehicular Ad-hoc Network

These guidelines will make sure that humans are less in contact with waste. Moreover automation will help the supervision in finding the minute details even regarding the waste produced, waste collection time and moreover the smallest details as well as intra vehicular communication. It is result is smart hospital as well as smart province and smart country with healthy living.

## 5. CONCLUSION

Hospital waste is an important and crucial case for health of patient, hospital staff, doctors and complete population that are living in closed area, city, province and complete country. Accumulating waste in Pakistan is causing major life threatening diseases. In order to avoid these problems, authors suggested use of T and 4G for making the waste supervision handling in automated way with lowest human intervention. These approaches will ensure the safety of patients and people as well as make the city or as whole country smart. It will also allow intra and inter vehicle communication making road journey safer and intelligent. In future, design of smart bins and trucks will be carried out. It also allows the supervision of waste at minute level. Data mining can be applied in order to keep track of waste and its disposal.

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