LUMEN ET VIRTUS

Hospital pneumatic tube: An ally of nursing for the quality of care provided to patients

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Fabiano da Costa Michielin[1]
Elisiane de Oliveira Machado[2]
Djulia Andriele Wachter[3]
Susana Rocha Costa[4]

ABSTRACT

The pneumatic conveying system, known as pneumatic mail, is very useful in terms of agility in internal hospital processes, moving or moving materials and samples of biological material between different sectors. Although essential, there is a gap in the literature on its effectiveness, highlighting the need for research. Invented in the nineteenth century, it evolved into complex networks after George Medhurst's first functional model. These systems are elementary in hospital logistics, transporting samples, medications, and documents quickly and safely. The study looks at its advances, including the use of artificial intelligence for pressure and speed control. The objectives are clear: to understand, highlight benefits and identify challenges to promote advances in hospital logistics. Despite the costs and challenges of implementation, the system offers efficiency, security, and resource savings. For nursing, it represents a valuable tool, freeing up time and promoting safety. In summary, pneumatic systems are essential allies in patient care, addressing time, safety, and operational efficiency.

Keywords: Health technology, Nursing, Durable medical equipment.

INTRODUCTION

Pneumatic conveying systems, also known as pneumatic mail, consist of a capsule pipes or Lamson pipes, are composed of a network of tubes through which cylindrical containers are propelled by compressed air or vacuum.[9]

In the hospital environment, it is a substantial technology, to support health for agility and speed in care processes, used to transport materials, medications, laboratory samples, documents, among others according to the institution's needs. This can occur between sectors or units of a hospital.[13] This technology was conceived in the nineteenth century by George Medhurst, an English

[1] Orcid: https://orcid.org/0000-0003-1731-0008
[2] Orcid: https://orcid.org/0009-0002-9227-1213
[3] Orcid: https://orcid.org/0000-0002-9127-3164
[4] Orcid: https://orcid.org/0000-0002-2504-6676

inventor, who created the first functional system in 1799. However, more elaborate and widely used systems were later developed by other inventors, such as Scottish engineer William Murdoch, who installed a pneumatic system on a bench in London in 1830. Pneumatic mail became especially popular in cities such as Paris and London during the nineteenth and early twentieth centuries, before gradually being replaced by other means of communication and transportation.[14]

Even with great importance in the practical scenario and great discoveries over the years, a scarcity is identified in the literature, pointing to the need for efforts to increase awareness about the importance and effectiveness of the "Hospital Pneumatic Mail", encouraging research and studies in this area. For this reason, this study aims to provide a clear and comprehensive understanding of hospital pneumatic tube systems, including their characteristics, functioning, and applicability. We also aim to highlight the potential benefits of these systems in terms of operational efficiency, patient safety, and resource savings. In addition, we aim to identify challenges and areas for future research, aiming to contribute to the continuous advancement of hospital logistics. In summary, this article will provide a critical and comprehensive analysis of hospital pneumatic tube systems, situating them in the broader context of hospital logistics. We hope that this work will stimulate further discussion and research on this topic, aiming to further improve the efficiency and safety of health services.

Pneumatic tube systems are an efficient way of internal transport of clinical samples, drugs, and medical supplies, through a vacuum and pressure system. A comprehensive understanding of this topic is essential for healthcare professionals, hospital managers, and researchers in the field of hospital logistics.

The rationale for addressing this topic is evident in the growing demand for more efficient and safer internal logistics systems in hospital environments. Pneumatic tube systems offer an agile and reliable alternative to traditional internal conveying methods, significantly reducing delivery time and minimizing the risks of cross-contamination. Additionally, implementing these systems can result in resource savings and increased patient satisfaction. In the professional practice of the nurses in this research, in a university hospital in southern Brazil, many contributions to patient care are identified that instigated the present research.

DEVELOPMENT

The development of the research will be divided into four topics, namely: **a)** concepts related to the pneumatic tube; **b)** Their contributions to nursing; **c)** contributions to the patient and, finally, the challenges related to this technology in the hospital environment.

TECHNOLOGIES AT THE SERVICE OF HEALTH IN THE HOSPITAL ENVIRONMENT

Health services need to have technological resources to solve logistical problems that require time spent to the detriment of the nursing professional's bedside presence. A technological tool that facilitates day-to-day activities are hospital pneumatic systems that play an important role in optimizing internal logistics, efficiently transporting blood samples and tubes within the healthcare facilities and pharmacy materials.[8] These systems utilize high pressure for rapid conveying over long distances, employing specially designed conveyors to minimize frictional forces.[9] Studies have shown that pneumatic tube conveying is acceptable for supplementary blood gases and analytes, with no significant differences between samples traveled and probed.[10]

THE PNEUMATIC TUBE

The pneumatic tube is a technological logistics tool that transports through capsules, materials, biological samples, medicines, among others, using a vacuum system, allowing transport over long distances in just a few seconds, offering practicality and agility. In this sense, innovations in pneumatic systems include models that use fuzzy logic, adaptive neural networks, and artificial neural networks to control pressure and speed based on the material being conveyed, increasing energy efficiency.[11] In addition, advances in conveyor prototypes have improved workflow, reducing hands-on time and minimizing the risk of errors during sample transport.[12]

CONTRIBUTIONS TO NURSING

The pneumatic tube system represents an innovation in hospital logistics, offering significant advantages to nursing in the transport of exams and medications, the speed and efficiency allows nurses to receive the necessary items in a matter of seconds, saving time in emergency situations or during critical procedures. This agility promotes a more agile response to patient needs, ensuring continuous and effective care.

In addition, the use of pneumatic tubing contributes to the reduction of human errors and material damage. By eliminating the need for manual transport, the likelihood of items being lost, damaged, or contaminated is drastically reduced.[15] Pneumatic tube systems are designed to ensure the safety and integrity of medications and exams throughout the transport process, providing nurses with peace of mind regarding the quality and reliability of the products that are being delivered to the sectors and received in the daily nosocomial routine.

Finally, the implementation of the pneumatic tube also promotes space and resource savings in the hospital environment. By replacing traditional trolley or manual transport methods, the pneumatic tube system frees up precious space in corridors and work areas, allowing for a more fluid circulation of patients, visitors and staff. In addition, the efficient use of hospital resources

contributes to the optimization of processes and reduction of operating costs, benefiting not only the nursing team, but the entire institution and its patients.

This technological tool is observed in a University Hospital where the authors work. The system is distributed in all areas of it, it consists of 75 stations distributed in all areas assistance, pharmacies, laboratories and transfusion agency, the stations have the function of firing and receiving samples, medicines, materials and blood components, in this context of structure the average of shipments are 2600 per day. For each group of materials sent, there is a specific capsule that is identified and there is a chip that sends the capsule to the determined location, which are: laboratory, blood bank and pharmacy. With this, it is possible to witness and encourage the use of this tool in hospital environments, considering the support of technology for nursing as a form of incentive and support for nursing professionals to have more time to be with the patient, who is so complex, dynamic and often unstable, thus being able to offer more and more humanized care, circumventing the logistical and bureaucratic routines that distance us from the patient.

CONTRIBUTIONS TO THE PATIENT

The use of the hospital pneumatic tube system plays a key role in ensuring a safer, more efficient, and more comfortable healthcare experience for patients. First, the speed and efficiency of the system are necessary to ensure that patients receive the necessary medications and tests in a timely manner. This is especially important in emergency situations, where every second counts, and also in procedures that require a quick response to ensure the effectiveness of treatment.

The safety provided by the pneumatic tube is notorious, by minimizing the manual manipulation of medications and exams, the system significantly reduces the risk of human errors, such as medication changes or product contamination. This ensures that patients receive the correct care in the proper dosage, improving the effectiveness of the treatment and preventing possible complications resulting from administration errors.

Another well-known aspect is the comfort it provides to patients. The use of the pneumatic tube helps to reduce long waits for the manual transport of medications and test results, providing a smoother and less stressful experience. This contributes to a more welcoming and humanized hospital atmosphere, where patients feel better cared for and supported during their stay in the hospital.

In short, the use of the hospital pneumatic tube system not only streamlines care processes and increases operational efficiency, but also represents significant importance in promoting patient safety and comfort, ensuring a more positive and satisfactory healthcare experience. Because it is

known that everything that contributes to agility and problem-solving capacity for the patient has a positive impact.

CHALLENGES OF HOSPITAL PNEUMATIC TUBE SYSTEMS

While the pneumatic tube system offers a number of benefits for hospitals and their patients, its implementation can face some significant challenges. One of the main objections is the initial cost of installing and maintaining the system. The infrastructure required for the installation of pneumatic tubes can be expensive, and the ongoing costs of maintenance and repairs must also be considered. This can pose a financial obstacle for hospitals with limited budgets.

Integrating the pneumatic tube system with the hospital's existing infrastructure can be complex. Hospitals need to ensure that the system is compatible with their medication and health information management systems, and that it is able to handle the volume of transport required to meet the demands of the institution.

Another challenge is the need for proper training for employees. Healthcare providers need to be familiar with how the pneumatic tube system works, including how to properly use the shipping and receiving terminals and how to ensure the safety and integrity of medications and tests during transport.

Issues related to data security and privacy may also arise. Hospitals need to ensure that the pneumatic tube system is secure from potential data breaches or unauthorized access to the materials being transported.

Finally, employee resistance to change and organizational culture can pose additional challenges. Some teams may be reluctant to abandon traditional methods of transportation in favor of the pneumatic tube system, which may require an additional communication and engagement effort on the part of hospital management.

Despite these setbacks, many hospitals are finding ways to overcome them and are reaping the benefits of the pneumatic tube system in improving the efficiency, safety, and quality of healthcare provided to patients. Since using technology in favor of actions aimed at patient care is a very significant point and deserves attention from hospital managers.

CONCLUSION

In conclusion, pneumatic conveying systems, or pneumatic mail, play a very important role in optimizing hospital processes, facilitating the fast and safe transport of essential materials between different areas, contributing to internal logistics in a substantial way. Despite the implementation challenges and associated costs, these systems offer significant benefits, including operational efficiency, patient safety, and resource savings. Continuous research and development in this area is

essential to maximize benefits and overcome challenges, especially in a context where efficiency and quality of healthcare are priorities. In addition, it is crucial to raise awareness of the importance and effectiveness of hospital pneumatic mail among healthcare professionals and hospital managers, encouraging additional investments and studies. By doing so, we can continue to improve the efficiency, safety, and quality of healthcare services, providing a more positive and satisfying experience for patients and healthcare providers.

Technological support goes beyond equipment, but the integration of these technologies into the nursing work routine contributes to what is most humane in care, which is the patient's biopsychosocial view. Considering that nursing has historically accumulated many attributions to its workload, and many of these demands remove the professional from the bedside, every resource that brings the professional closer to the patient can contribute to the provision of better care. If we consider the distances traveled to access support services, we evidence in the technology of pneumatic mails a robust ally to patient care, we are addressing time, professional fatigue, safety and resource savings.

In environments where the pneumatic tube is already present, it is so incorporated into the work routine that it is little noticed. We contributed to this by identifying a scarcity in the health literature on the subject, despite its consolidated and relevant role in the hospital environment. In view of this, we suggest further studies on the pneumatic tube and its benefits, in order to instigate further investigations.

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