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## **Prevention of infections: the Karol and Maria Hospital for Children, Warsaw, Poland**

The COVID-19 pandemic caused many changes in hospital healthcare around the world<sup>3</sup>. New hospitals are being built only to treat infected patients, and in existing hospitals, wards are being set to hospitalise patients with suspected or diagnosed infections. In most hospital emergency rooms, all or some of the patients admitted to the hospital are tested for infection and waiting rooms for patients with test results pending are

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- 3 W. Carroll, V. Strenger, E. Eber, F. Porcaro, R. Cutrera, D. Fitzgerald, I. Balfour-Lynn, *European and United Kingdom COVID-19 pandemic experience: The same but different*, “Paediatric Respiratory Reviews” 35 (2020), pp. 50–56.

being created. Unfortunately, in many cases these measures fail and outbreaks of nosocomial infections occur.

Let us therefore briefly recall what attempts were made to prevent nosocomial infections, a practice understood at the time as preventing the mixing of infectious and non-infectious patients, in the Karol and Maria Hospital for Children in Warsaw, which opened in 1913<sup>4</sup>.

### **The Karol and Maria Hospital for Children, Warsaw, Poland**

The hospital [Figure 1], consisting of nine pavilions, was founded by Zofia Szlenkier, a daughter of rich Warsaw industrialists. It was very modern for its time, and was considered “well thought-out” by visiting physicians<sup>5</sup>. The opinion resulted from the fact that its first Chief Physician, Dr Józef Brudziński, actively participated in all stages of construction, from the blueprints of the pavilions to the design of hospital interiors<sup>6</sup>.

A number of innovative systems were in place in the Karol and Maria Hospital for Children in Warsaw to prevent nosocomial infections. They are listed below and successively discussed:

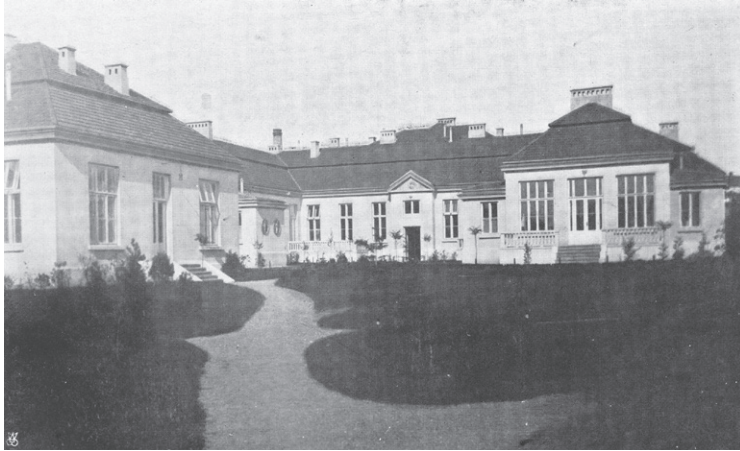
- the hospital was built in the pavilion system, with some hospital pavilions designated for the treatment of infectious patients and some for non-infectious patients; outbuildings were located between the infectious and the non-infectious sections to allow accessing them was from the “infectious” and “non-infectious” sides.
- treatment of children with a single infectious disease was limited to one pavilion: a system of individual isolation based on separate cubicles operated inside the pavilions
- an observation pavilion with cubicles was constructed specifically for patients suspected of infectious diseases as yet undiagnosed,
- a system for dividing patients into potentially infectious and non-infectious as soon as patients enter the outpatient clinic from the street,
- appropriate arrangement of pavilions and hospital roads so that infectious and non-infectious patients do not meet.

4 J. Brudziński, *Szpital im. Karola i Maryi dla dzieci (Urządzenia i zarządzenia, związane z zapobieganiem chorobom zakaźnym)*, “Przegląd Pediatryczny” 6 (1914), pp. 97–143;

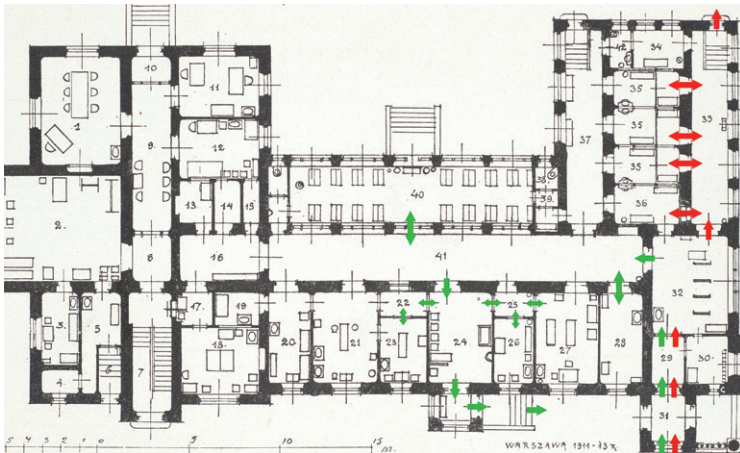
J. Brudziński, *Organizacja pracy lekarskiej w szpitalu im. Karola i Maryi dla dzieci w Warszawie*, “Przegląd Lekarski” (1914), No. 2: p. 28; No. 3: p. 41; No. 4: p. 48.

5 J. Brudziński, *Słów kilka o postępach szpitalnictwa dziecięcego*, “Czasopismo Lekarskie” 1 (1905), pp. 62–66.

6 W. Szenajch, *Józef Brudziński*, “Gazeta Lekarska 3 (1918), pp. 17–22.



1. General view of the hospital



2. Plan of ambulatory building



3. Sorting plant

The fight against nosocomial infections started in Karol and Maria Hospital for Children in Warsaw as soon as a child was referred to the hospital, and followed the plan developed by Brudziński.

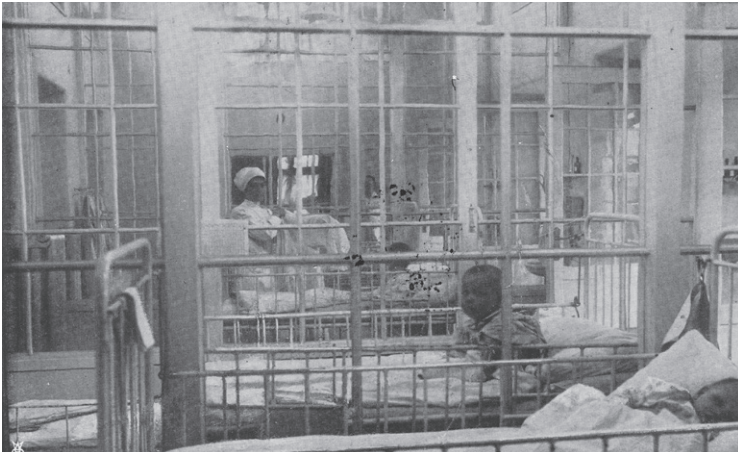
The outpatient clinic, whose plan is shown in Figure 2, was used to admit patients. Its building was set back from other pavilions, and was entered directly from the street. Before the child was allowed to enter the hospital, the nurse on duty asked through the window if the child had some rash and if the mother suspected any infectious disease. In case of such suspicion being confirmed, the child was immediately taken to a special isolation ward with the entrance from the outside (isolation wards are described in greater detail below), where they awaited an appointment with a physician. Other patients (along with their mother or caregiver) entering the outpatient clinic were directed to an area called sorting room [Figure 3] or a waiting room with cubicles [No. 32 in Figure 2]. Each cubicle was occupied by only one patient with an accompanying caregiver. It was still in the cubicle that the nurse, after taking the history, and examining the patient's skin and throat, decided which of the patients was suspected of having an infectious disease. Such patients were directed along the infectious path [red arrows in Figure 2]: first along a special corridor [No. 33 in Figure 2] to the isolation rooms [Nos 35 and 36 in Figure 2], where they waited to be examined by a physician. The physician entered the isolation ward through another entrance (different from the one for the patients), from the clean corridor [No. 37 in Figure 2]. On entering the isolation ward, the physician put on an apron, and another one on entering the isolation room. The latter was left in the isolation room after patient examination.

Having been examined by the physician, an infectious patient did not return through the isolation room, but was directed along another corridor to the exit straight into the street designated for infectious patients [No. 33 in Figure 2]. In turn, the patients who required a stay in the hospital were directed along a special route to the appropriate infectious pavilion.

Patients considered non-infectious were directed from the sorting plant along the non-infectious path [green arrows in Figure 2] – along the non-infectious corridor [No. 41 in Figure 2] to the waiting room [No. 40 in Figure 2] arranged into a glazed veranda with benches for two, designated for the child and the mother; the benches were scattered throughout the waiting room to minimize the risk of contact between patients. To avoid walking across the entire waiting room, toilets were provided at both ends. In the waiting room, there was a fountain letting children drink



4. Summer waiting room



5. Isolatory cubicles

water without using cups. In summer, children could go out into the garden, which served as a summer waiting room [Figure 4], through the balcony door.

Doors from the waiting room led to four doctor's surgeries: two for internal medicine [Nos 26 and 27 in Figure 2], one for throat, nose, ear, and eye patients [No. 28 in Figure 2], and one for surgical patients [No.23 in Figure 2]. There was also an operating theatre [No. 21 in Figure 2], a plaster dressing room [No. 20 in Figure 2], and a sterilisation room [No. 19 in Figure 2]. Having received medical advice, children left the outpatient clinic without passing through the common waiting room.

In addition, the outpatient clinic housed an orthopedic unit [No. 2 in Figure 2] with instruments for the treatment of spinal curvature and other body deformities, and a light therapy room [No. 6 in Figure 2] with a separate entrance and changing room.

In the non-infectious pavilions housing the internal and surgical wards, there were 4 cubicles, or glazed rooms, each with a separate window [Figure 5]. Each newly arrived child was placed in a cubicle. Children were only moved to the general room after they were deemed to have no infectious disease. Each ward had separate entrances for patients and for the medical staff. Each pavilion also had a light therapy room with a quartz lamp and a room intended for the "hopeless cases", which allowed to isolate children in terminal condition, so as to "spare the other children's emotions". Each ward had 2 bathrooms, toilets, washrooms, a handy kitchenette, and dirty linen rooms. Surgical and internal wards had day-care rooms designed for recovering patients. Each room in the ward had its own easily accessible terrace, where the children could move to in good weather.

The observation pavilion consisted of five isolation wards: glazed rooms with an upper window for ventilation. Children entered each isolation ward from the outside, through a heated vestibule with a bathtub. There was a washbasin and handy utensils such as a thermometer, a can of cotton wool, etc. in each isolation ward, apart from the obvious bed and table. Another entrance led to each isolation ward from the clean corridor, which ran on the side opposite to the vestibule and was only intended for hospital staff. The corridor was equipped with a container of disinfectant fluid for disinfecting hands after leaving the isolation ward and a shoe wiping station. The pavilion was designed as an "independent hospital within a hospital": it had a handy kitchenette, a washroom, a dirty linen room, a storeroom for linen, etc., as well as a small operating theatre only intended for the patients of the pavilion. The pavilion also

featured a doctor's surgery, a nurse's room, and a dedicated bathroom and toilet. All in order to reduce the number of contacts and the potential of transmission.

Pavilions for the treatment of specific infectious diseases such as diphtheria and scarlet fever were designed to be largely self-sufficient, which means they all had small surgical rooms. Here, great attention was paid to preventing transmission of the infection by doctors and nurses. While leaving the pavilion, both the doctor and the nurse left their clothes in the room, changed into a white coat and went to the washroom. Only there, after taking a bath, they changed into clean clothes. Parents could visit their hospitalised children once a week, but each time only after taking a history of infectious diseases at home. If a family were diagnosed with an infectious disease, admission to the ward was prohibited.

The hospital kept strict records of all cases of nosocomial infections, which were reviewed and regularly discussed to prevent further incidents.

## Discussion

It is important to remember that the history of hospitals exclusively for children had been very short before 1913. Hospitals for adults only opened rooms for treating sick children and small hospitals for children opened in private apartments only early in the 19th century<sup>7</sup>. The first hospital in Europe designed to treat children and not just to care for them was established in Paris in 1802. It had not been until the second half of the 19th century that hospitals for children were commonly built in most European countries and in North America. In Poland, the first such hospital was established in Lviv in 1845. By 1908, about 200 hospitals for children had been built worldwide<sup>8</sup>.

Quite naturally, the builders of hospitals for children could rely on the experience gleaned from hospitals for adults, but the specificity of children's diseases suggested that the solutions that worked in hospitals for adults did not necessarily work in a hospital designed to treat children only<sup>9</sup>.

7 S. Radbill, *A history of children's hospitals*, "The American Journal of Diseases of Children" 90 (1955) No. 4, pp. 411–416.

8 A. Marek, *Szpitala dziecięce w Europie 1802–1908*, "Medycyna Nowożytna" 13 (2006), pp. 79–92.

9 P. W. Smith, K. Watkins, A. Hewlett, *Infection control through the ages*, "American Journal of Infection Control" 40 (2012) No. 1, pp. 35–42.

The solutions proposed in the Karol and Maria Hospital for Children in Warsaw, which was Warsaw's third hospital dedicated exclusively to the treatment of children, were the result of plentiful study tours taken by its founder and first Chief Physician, professor Józef Brudziński, who among others visited hospitals and treatment facilities for children in Paris, Graz, Vienna, Wrocław (Breslau), London, Berlin, and Budapest<sup>10</sup>.

The first solutions to reduce nosocomial infections were applied in 1869, when Karl Rauchfuss, a Russian pediatrician, built the Prince Oldenburg Children's Hospital in St Petersburg based on the pavilion system, placing children with infectious diseases in separate pavilions. Since then, the system was employed in all newly established European hospitals for children<sup>11</sup>.

Reducing the hazard of children infecting one another throughout the hospital, the pavilion system did not solve the problem of patient isolation. Numerous cases with undetermined diagnosis of infectious diseases, cases with mixed infections, and children admitted to the hospital in the initial stage of infectious diseases remained a major problem. New solutions were sought. One of them, applied for the first time in France, was to isolate patients inside pavilions. Attempts were made to introduce separate rooms, or glass or mesh screens separating patients. Moreover, cubicle systems were introduced to enable total (closed cubicles, i.e. small, glazed rooms) or partial (various types of separators between beds) isolation of patients inside the room<sup>12</sup>.

On the other hand, the barrier system was widely used in London. It relied on separation of the patient's bed by means of a band or just a large distance between the beds, and the use of only sterilised household items by patients. Yet all these systems made use of common ventilation systems, usually based on holes in the windowpanes. That resulted from the conviction that infectious diseases were commonly transmitted through direct or indirect person-to-person contact. On the other hand, infection "through the air" was only deemed possible within a small space around the patient<sup>13</sup>.

It can be assumed that the Karol and Maria Hospital for Children in Warsaw concentrated, like a lens, the most modern ideas of European

10 W. Szenajch, *Józef Brudziński*, footnote 5.

11 A. Marek, *Szpitalne dziecięce*, footnote 7.

12 J. Brudziński, *O szpitalnictwie dziecięcym w Paryżu*, "Medycyna" 20 (1900), pp. 468–472.

13 J. Brudziński, *O szpitalnictwie w Londynie*, "Medycyna" 25 (1900), pp. 595–597.



hospital design that were verified by the critical and practical mind of Józef Brudziński. In 1923, the Karol and Maria Hospital for Children in Warsaw was named “Thopital modele” by Dr Jean Comby, editor-in-chief of “Archives de Medicinedes Enfants” monthly, and as such became known to all involved in hospital treatment of children. In the first decade of its operation, it was visited by several thousand people from different countries<sup>14</sup>.

Józef Brudziński enjoyed the recognition of not only fellow Poles but also foreigners, as evidenced by the fact that the Association Internationale de Pediatrie entrusted him with the keynote speech on the prevention of nosocomial infections at the 2nd International Pediatric Congress held in Brussels in 1915.

It is worth noting that all the solutions presented in the hospital were designed before 1918, that is before the Spanish flu pandemic, which caused the death of millions of people around the world. The pandemic also became a turning point for rethinking many solutions in outpatient and hospital healthcare designed to reduce the transmission of infectious diseases<sup>15</sup>.

The authors admit to being impressed by many of the solutions introduced in the Karol and Maria Hospital for Children in Warsaw over a century ago, at a time when there was much less knowledge about infectious diseases in children. Even today, many of such solutions are worth applying in contemporary hospitals for children.

14 W. Szenajch, *Józef Brudziński*, footnote 5.

15 B. J. Jester, T. M. Uyeki, A. Patel, L. Koonin, D. B. Jernigan, *100 Years of Medical Countermeasures and Pandemic Influenza Preparedness*, “The American Journal of Public Health” 108 (2018) No. 11, pp. 1469–1472; K. R. Short, K. Kedzierska, C. E. van de Sandt, *Back to the future: Lessons learned from the 1918 influenza pandemic*, “Frontiers in Cellular and Infection Microbiology” 8 (2018), p. 343, <https://doi.org/10.3389/fcimb.2018.00343>.

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# Abstract

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*Prevention of infections: the Karol and Maria Hospital  
for Children, Warsaw, Poland*

The COVID-19 pandemic caused changes in the operation of children's hospitals around the world. The prevention of the spread of infections is one of the most pressing issues faced by everyone involved in medical care. The following article reminds what the Karol and Maria Hospital for Children in Warsaw opened in 1913 did to prevent nosocomial infections. At the time, this hospital was one of the most modern in Europe, and the solutions it offered were welcomed with admiration and amazement. Even if not widely used, many of them seem relevant today.

**Keywords:**

nosocomial infection, hospital

# Abstrakt

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*Zapobieganie zakażeniom:*

*Szpital Dziecięcy im. Karola i Marii w Warszawie*

Pandemia COVID-19 spowodowała zmiany w funkcjonowaniu szpitali dziecięcych na całym świecie. Zapobieganie rozprzestrzenianiu zakażeń jest jednym z najbardziej naglących problemów, z którymi spotyka się opieka medyczna. W poniższym artykule chcemy przypomnieć, w jaki sposób usiłowano zapobiegać zakażeniom wewnątrzszpitalnym w Szpitalu dla Dzieci im. Karola i Marii w Warszawie, otwartym w 1913 roku. Szpital ten był wówczas jednym z najbardziej nowoczesnych w Europie, a rozwiązania w nim proponowane budzą podziw i zdumienie. Wiele z nich nadal wydaje się być użytecznych, chociaż nie stosuje się ich powszechnie.

**Słowa kluczowe:**

zakażenia wewnątrzszpitalne, szpital