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Designing maternity care spaces: a research design process involving staff and users' requirements to improve a Midwifery-Led Unit layout

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Abstract: The research study aims to identify the optimal birth layout according to users' needs and staff organization to support the design of a new Midwifery-Led Unit in Italy. Midwifery-Led Units are connected to reduced childbirth medical interventions and better health outcomes. This model of care needs a proper architectural response that lacks knowledge around physiological birth space design. The Research Group (architects, environmental psychologists and midwives) entrusted with reshaping an existing Midwifery-Led Unit project analyzed how to better respond to the specific spatial and organizational needs. The process, initially based on literature review, case studies and interdisciplinary meetings, led to the analysis of critical aspects of the preliminary project. Supplementary research was conducted to investigate relevant architectural topics and set new requirements to understand stakeholders' needs. Spatial layout analysis was compared to users' perceptions, experiences, thoughts and expertise collected through questionnaires and focus groups. The research identified new requirements and design suggestions to address the future design process and created a new layout for a Midwifery-Led Unit. As translation of spatial and environmental users' needs, the results increased the knowledge about birth spaces and represented an innovative model for Hospital Management and Technical Office. The findings represent the base field for creating a built environment that improves health outcomes, achieves healthy behaviors, and fosters staff practice inside a traditional and rigid hospital layout.

Keywords: healthcare facilities; birth spaces; users' needs; spatial layout

1. Introduction

In the last twenty years, we have seen, almost all over the planet, an exponential increase in the rate of caesarean and unnecessary medical interventions at birth. The Euro-Peristat Project Report (2018) shows a serious situation in Europe as the critical threshold defined by the WHO is a rate of 15%. Studies have shown how the excessive use of caesarean and medical interventions at birth (such as episiotomy, induction), when not necessary, lead to influence the health conditions of the woman, with implications also in the long term, for example, on epigenetics and chronic diseases (Dahlen et al, 2016). In Italy, the average of caesarean sections stands at 31%: a greater distribution in the central south and some areas of the north of the country (Ministero della Salute, 2020).

To tackle this problem, in recent years, different types of directives and guidelines have been issued to encourage and support physiological birth: at the international level, for example, the WHO released Recommendations (WHO, 2018a; 2018b); in Europe, the standards for managed units of midwives have come out (Rocca-Lehnacho et al., 2018); in Italy, the Ministry of Health launched the recent guidelines for low midwifery risk that provide indications for the management of low-risk pregnancy and childbirth by midwives as a modality associated with a reduction in medical interventions (caesarean section, episiotomy) and greater satisfaction of women (Ministry of Health, 2017).

Therefore, it is recognized that the Midwifery-Led Units / Birth Centres are connected to reduced childbirth medical interventions and better health outcomes (Sandall et al., 2016). This model of care needs a proper architectural response that lacks knowledge of physiological birth space design. Many research studies in health sciences and architecture have been carried out on the influence of space on the labour and delivery process (Nilsson et al., 2020), with important results confirming the role of the built environment, its impact on the physiological birth process and women's experience and midwifery practice and behaviour (Foureur et al. 2010; Setola et al., 2018).

However, we observe a shortage of this kind of information in the application of technical guidelines and, among the professional designers, a lack of knowledge about birth physiology and its consequent application to the architectural project.

Following the request by the Italian Ministry of Health to the Regional Health Trusts to equip themselves with physiological areas with low midwifery risk within the maternal and child departments, some hospitals have decided to improve the conditions of assistance for users by building new facilities or renovating some parts of them to accommodate those areas, such as Midwifery-Led Units / Birth Centres.

The case examined in this paper concerns the collaboration carried out by the research group with one of the hospitals building a new Maternal Child Pavilion, which includes a Birth Centre within it. This centre is equipped with five birth rooms and is located on the second floor of the new pavilion, on the same floor as the midwifery and gynaecology wards. In contrast, the traditional labour-delivery area is located on the ground floor and connected through the elevators.

The entire research collaboration aimed to investigate the relationship between space and users' perception of birthplaces, identify the best spatial and environmental conditions for the new Birth Centre, and support a participatory process for users, which would help implement the awareness of birth as a physiological event. In this paper, we focus on the process of spatial design research and the description of the Birth Centre's final layout elaborated by taking into account the users' requirements detected along with the collaboration with midwifery and environmental psychology disciplines.

2. Theories and Methods

The hospital was already in possession of a preliminary design project for the entire Maternal and Infant building, including the Birth Centre area. Then the research group was entrusted with reshaping this existing Birth Centre project to better respond to the specific spatial and organizational needs. The research was developed in three phases: 1) the evaluation of the existing project according to the requirements given by the scientific literature; 2) the analysis of the spatial layout and the users' perception, helping to identify the best environmental conditions; 3) the drafting of guidelines for the project and the new design solution which should be the subject of a future co-design process.

In phase one, the critical aspects of the layout were identified according to the results that emerged from the scoping review by Setola et al. (2019) and the knowledge acquired by the research group after the field visits to more than fifteen birth centres in Europe. These critical aspects of the preliminary project were identified (Figure 1):

- The position of the accesses and, therefore, the paths of the entire floor seems to suggest the possibility that the Birth Centre is a transit for other hospital users, thus creating an interference of different flows;
- The dispersion of the spaces dedicated to the work of midwives could alter their management and control skills, as well as decrease internal communications. The staff may not carry out the reception functions in the unit if this does not coincide with the working station;
- The dispersion of spaces for socialization, such as living rooms and kitchens, does not favour communication and sociability between the different users (midwives, supporters, mothers);

- The lack of a visual message revealing the birth philosophy of the centre. It is important to give the unit a character and distinctive identity from the outset: the views that open at the entrance and in the internal path from the corridors to the rooms are important to strengthen the communication of positivity. The area dedicated to the entrance must have a defined character to instil in the visitor not only ease of orientation but also the perception of transition in a "non-hospitalized" environment;
- The elongated shape of the room dedicated to the three great moments of the birth event (labour, birth, post-birth) prevents optimal use of the available square meters as it requires a serial arrangement of the furnishings and does not allow for different configurations to be identified in accordance with the needs of these three moments;
- The proximity of social spaces to the birth rooms could lead to problems in the control of noises that would compromise privacy and control and the woman's ability to relax. From the literature studies, it is not clear whether a separation of the unit between the more social area and that of the rooms is a positive element or a detriment to the sense of openness that the birth centre should offer to users;
- The articulation of the space in the birth room does not favour the freedom of movement and flexibility of the environment to ensure maximum emotional and physical freedom of the woman who needs different situations depending on the stages of labour and delivery;
- The bed has a dominant position in the room and constitutes the visual and emotional focus of the environment. It is proposed as a preferential place in which to give birth, to the detriment of using more functional positions for physiological birth. The type of bed can significantly affect the atmosphere of the environment as well as the flexibility and practicality of the room. Some studies recommend not to use a regular hospital bed, but preferably a double bed, as well as a mobile bed to give the environment as much flexibility as possible;
- The lack of furniture to facilitate physiological childbirth, such as a tub, birthing couch, ball, bars, lianas, bean bags, and furniture for the comfort of users (e.g. wardrobe for personal items, seats for supporters). The furnishings and objects to support childbirth are fundamental elements both for the practice of childbirth and for the organization of space. The goal is to offer as much support as possible to the various activities of women without reducing the degree of flexibility of the room;
- The lack of an adequate interface space between room and corridor to preserve the sense of privacy, control and relaxation. It is assumed that the activities taking place in the room should not be seen from the outside corridor. Therefore, together with a strategic location of the furnishings concerning the entrance, an additional device is recommended to mitigate the room's exposure.

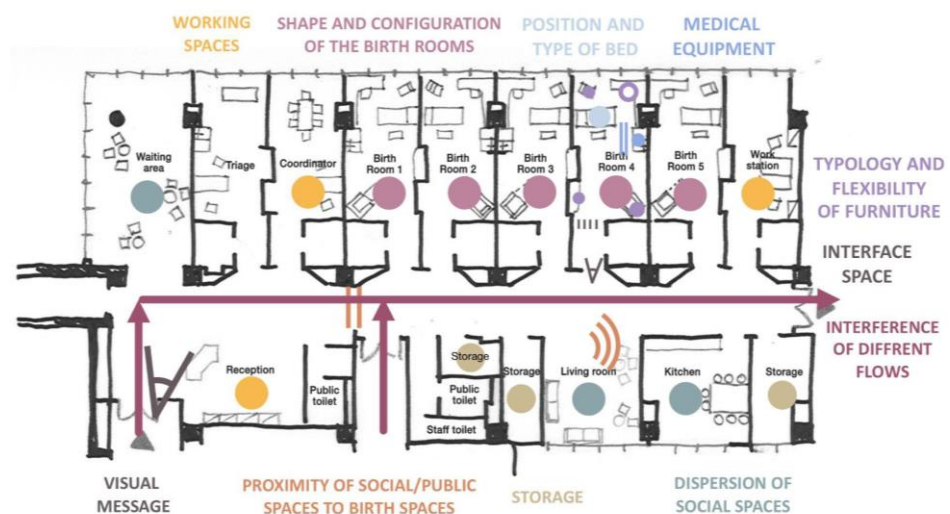


Figure 1. Preliminary project layout and critical aspects. The colour of the big dots is related to the writing of the same colour (© TESIS -DIDA)

To better investigate some relevant architectural topics and set new requirements, phase two was dedicated to understanding stakeholders' needs. Spatial layout analysis, users' perception questionnaires, and focus groups were used to achieve this goal. The spatial analysis was conducted through field visits to the existing facility and configurational layout analysis in which geometric measurements were detected, such as distances, heights, and sizes, but also configurational measures such as Integration and Visibility through the use of Space Syntax techniques (Hillier, 2007). The perception of users (mothers and midwives) was detected through the administration of questionnaires concerning the affective quality of spaces (Perugini et al., 2002), humanization (Andrade et al., 2012), experience (Fenaroli and Saita, 2013), and BESP questionnaire specifically built for the physical characteristics of the space, and focus groups. Employing the interpretative analyses of the data through statistical software, they were then compared to the spatial data to find associations that confirmed the importance of some topics for women and midwives and to identify measures that could represent these issues and guide the project. The specific results of these analyses are reported in a paper by Setola and al. (2022).

The translation of spatial and environmental users' needs emerged from the questionnaires and focus groups and led to the creation of inputs for the new Birth Centre design that concerns four areas: unit configuration, midwifery desk position, common spaces, and birth room (Table 1). Following these design guidelines, a new layout proposal was developed, which is now being examined by the hospital's stakeholders.

Table 1. Inputs for the new layout design according to users' needs.

| UNIT CONFIGURATION |
|-------------------------------------------------------------------------------------------|
| Creating an area isolated from the flows of the surrounding wards |
| Humanizing space with furniture quality, natural light, external views |
| Decreasing medicalized and standardized layout configuration such as corridor-rooms |
| Favouring clarity in wayfinding and services such as food areas |
| Favouring the possibility for mothers to walk spaces outside the birth room during labour |
| MIDWIVES SPACES |
| Locating midwives' desks in central position and control of the unit |
| Inserting relaxing space for midwives |
| Reducing distances from desk to birth rooms |
| Reducing the proximity of the midwives' working spaces to social spaces |
| Creating a midwives' desk not totally exposed on the four sides |
| Inserting a briefing space |
| COMMON SPACES |
| Designing good quality furniture |
| Favouring natural light |
| Creating a restoration space (kitchen and dining room) for all users |
| Positioning common spaces near the entrance and far from birth rooms |
| Provide waiting/relaxing areas for partners/supporters near birth rooms |
| BIRTH ROOM |
| Creating one room for labour, birth, post-partum |
| Having the possibility of a shower in the birth room |
| Having the possibility to control natural and artificial light |
| Having the possibility to enjoy natural light according to the needs |
| Creating enough space for movement during labour |
| Favouring a square shape more than a rectangular shape |
| Creating an interface space between the birth room and corridor |
| Creating technological solutions to guarantee appropriate acoustic isolation |
| Locating the birth room far from noise environments |

Creating design solutions for inside-outside interfaces to guarantee privacy
 Allowing a suitable welcoming space for partner/supporters
 Taking care of environment quality (materials, furniture, colours)
 Creating design solutions to hide medical equipment
 Allowing the possibility to personalize space and furniture

3. Results

The new project proposal for the Birth Centre developed by the research group consists of a new layout that takes into account two main considerations. First of all, the project considers users' requirements detected in Phase 2. Secondly, the new layout respects further plant-engineering constraints that emerged during the design process: a reinforced concrete frame building with the presence of fixed shafts for vertical systems (water and sanitary) and ventilation and aeratic systems passing from the false ceiling. The plant and structural requirements had to be respected as planned for all floors of the building.

We describe below the new layout of the project according to four themes.

3.1. Relationship between social/public and birth activities

In the new layout (Figure 2), there is a concentration of social spaces at the entrance, with the kitchen/ living room placement immediately in the view from the entrance. This design choice, on the one hand, limits the noise and flows in the area dedicated exclusively to birth; on the other, it maximizes the possibility of communication and socializing among users.

The other point is the birth philosophy transmission that considers the visual message received upon entering the Unit that should reveal the philosophy of the organizational model. It is important to give a characteristic and distinctive identity of the Birth Centre from the beginning, through the views of the entrance and then throughout the entire path to the birth rooms, to strengthen the communication of positivity. The entrance must also have a delineated character to encourage orientation and the perception of transition to a non-hospitalized environment.

As stated above, the choice of separating the more public and social activities from those related to birth limits the interference of noise and flows that would compromise the ability of mothers to relax, control the space, and feel privacy and intimacy within the birth rooms. The birth rooms have a dedicated corridor, almost of exclusive pertinence, as the area hosts only the birth rooms and their storage and is separated from the public flow.

Finally, waiting areas immediately facing the birth rooms are designed to let the supporters/partners wait next to the women.



Figure 2. New project proposal: the relationship between social/public and birth activities. (© TESIS -DIDA)

3.2. Midwives' desk position and its role in the layout

The midwives' desk and the other working spaces are centrally located in the unit, ensuring maximum user flow control (both external visitors entering the unit and women) (Figure 3). The new proposal poses the desk in a barycentric position. Thanks to its advancement with respect to the structural grid, it has good visibility of the entrance, public areas and the birth rooms. Midwives preside over the junction point between the most public and the most private area.

Another choice strongly characterizes the midwives' spaces: both the desk and the back office are placed at a single point instead of being diffused in more units' rooms. The decision to unify their location respects the organizational model and improves midwives' work. The model does not foresee a person at the reception desk in continuity, so midwives manage to carry out the functions of acceptance, reception, and assistance from a single location.

The new project also includes a support space for midwives to rest and relax. It is placed near the working position and, thanks to a glass wall towards the public entrance area, allows midwives to remain vigilant about the events inside the birth centre.

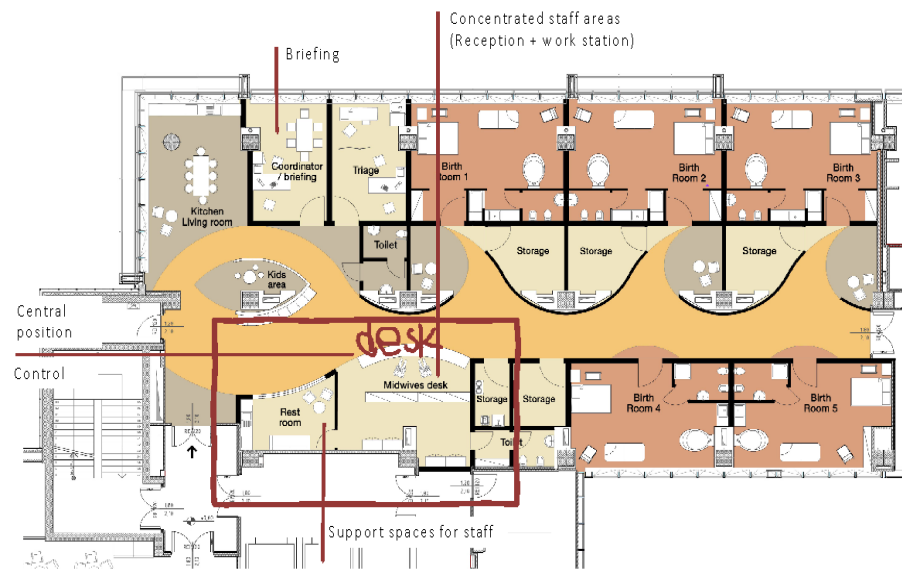


Figure 3. New project proposal: midwives' desk position and its role in layout. (© TESIS -DIDA)

3.3. Intended use and dimension comparison

The new layout (Figure 4) highlights some dimensional and distribution choices that lead to an optimization of the functions and their dimensions. Table 2 shows the most modified environmental units. The birth rooms and their toilet, highlighted in orange, have a greater amount of square meters and storage in the new proposal. Conversely, both public and staff toilets have been reduced: the public one from two to one, and the toilets for the staff from three to two. Another choice that has led to dimensional savings is the distribution and type of social spaces. From having a separate kitchen and living room, in the new layout, these spaces have been united and overlapped in a single room, offering a space to cook and eat, but also to socialize or relax.

From being concentrated in one place, the waiting areas are spread in the unit in various little locations. The staff area combines activities of acceptance and work. This saving of space has led to the possibility of introducing the rest area for staff and the children's area.



Figure 4. New project proposal: intended use and dimension comparison. (© TESIS -DIDA)

Table 2. Main differences between the preliminary and new projects.

| Spaces | Preliminary project | New project |
|-----------------|---------------------|--------------------------|
| Birth rooms | 172 m ² | 208 m ² |
| Storages | 30 m ² | 47 m ² |
| Public toilets | 2 | 1 |
| Staff toilets | 3 | 2 |
| Social spaces | Kitchen | Kitchen + Living room |
| | Living room | |
| Waiting area | Concentrated | Spread |
| Staff areas | Reception | Reception + Workstation |
| | Workstation | |
| Staff rest area | missing | 1 |
| Children's area | missing | 1 |

3.4. Characteristics of the birth room

The new project (Figure 5) proposes a new configuration of the birth room with a 'squarer' shape to optimize the square meters. The room is not simply bigger, but especially its shape and configuration offer greater freedom of movement and flexibility of the environment, which can assume different configurations by moving the furniture and creating different spatial situations. The new configuration helps the mothers to have the maximum emotional and physical freedom during the three significant moments of the birth event: labour, birth, and post-partum.

In addition, an interface space is designed between the corridor and the door of the birth room so that the visibility of the room from the public space is greatly reduced. This positively influences the sense of control and relaxation for mothers and provides a greater sense of privacy and capacity for autonomy and control of women and a greater perception of security.

The furnishings selected for the new layout mirror the search for greater intimacy and domesticity to favour the physiology of childbirth and better physical and psychological conditions. The furnishings and objects supporting childbirth are fundamental for the practice of childbirth and the organization of the space. Their choice and arrangements

aim to give as much support as possible to the different activities of women without reducing room flexibility degree.

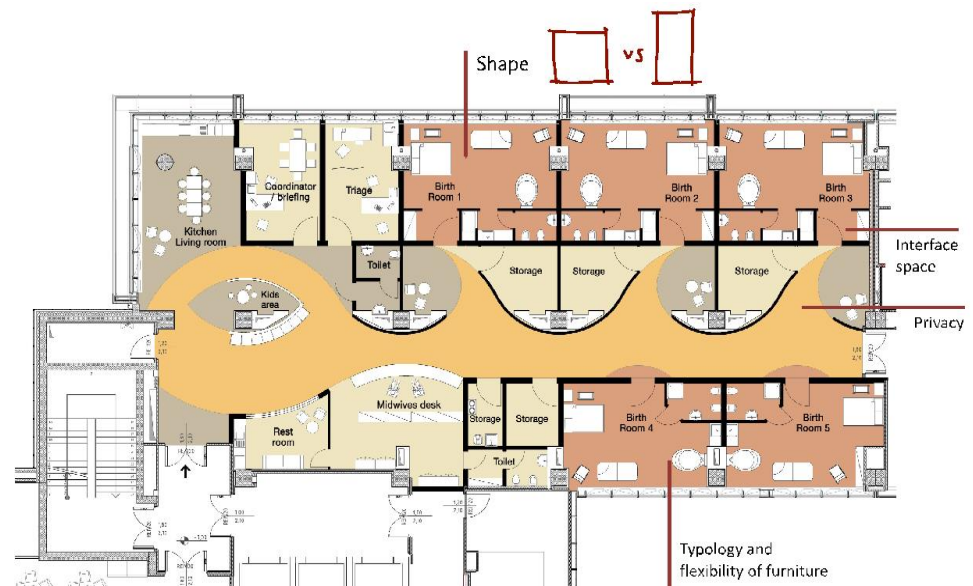


Figure 5. New project proposal: characteristics of the birth room. (© TESIS -DIDA)

4. Discussion

The research path characterized by interdisciplinary meetings, surveys of user needs, and the critical analysis of the initial layout made it possible to highlight various design aspects. The new design solution shows that it is possible to distance oneself from a traditional hospital system design, characterized by rigid structural and plan constraints, and create something more distinctive, better focused on the organizational and care model required, and on users' needs. The building is a triple-bodied courtyard layout, similar to many others on the national and international scene.

The feature that immediately emerges by observing the layout is the use of curved lines both in the walls and in the flooring to define the spaces. This element is found in the scientific literature as an expression of the philosophy underlying the birth event (Lepori, 2008). Together with the other design choices illustrated above, such as attention to the entrance, the midwives' workstation, the presence of social spaces, the care and extensiveness of the birth room, they demonstrate how the physiology of birth can be applied to the architectural project. It is not just about building beautiful rooms equipped with comfortable colours and furnishings, but a commitment from the designer is required during the design of the spatial layout.

However, some problems remain open, such as the presence of natural light in the midwives' station and the possibility of creating a space dedicated to training and information for the community, which could represent a good means for disseminating the Birth Centre philosophy. These topics will be discussed directly with the operators. The layout proposal presented here will be the base of some co-design sessions with the hospital staff to identify further detailed improvements.

5. Conclusions

The project provides evidence of the importance of the interdisciplinary approach. The findings represent the base for creating a built environment able to improve health outcomes, achieve healthy behaviours and foster staff practice. The research identified new requirements and design suggestions to address the future design process and project and created a new layout for a Midwifery-Led Unit. As translation of spatial and environmental users' needs, the results increase the knowledge about birth spaces and represent innovative hospital management and technical office model.

Contributor statement

Author 1: Conceptualisation, Writing-Original Draft, Methodology, Funding acquisition. Author 2: Formal Analysis, Visualisation, Writing-Original Draft. Author 3: Writing-Original Draft, Writing –

Review & Editing. Contributors in environmental psychology Laura Migliorini and Paola Cardinali: Methodology, Data Curation, Formal Analysis.

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