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Design for All: Strategy to Achieve Inclusive and Healthier Environments

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1 Introduction

Health is a value currently associated to a social model, that results from social, cultural and economic factors, as well as environmental [1]. The International Classification of Functioning, Disability and Health (ICF) [2] indicates health and disability as conditions reliant by a plurality of factors, including Environmental and Personal factors. Indeed, different scientific studies demonstrate that design features can influence people behavior and well-being [3–5]. In particular Evidence-Based Design (EBD) methodologies prove that the physical environment can have impacts on users' health related outcomes and performance (e.g. reducing staff stress and fatigue, improving patient safety, reducing family stress, improving communication between staff and patient and overall satisfaction) [6–8]. This is especially true in in healthcare facilities as a place where physical, perceptive, cognitive and social aspects should be considered in the design as main priorities, since people and environment influence each other [9, 10].

Although different factors can influence users' well-being, health and safety, architectural environments often have not been designed considering the people's perception, usability and experience within the space [11]. This can compromise the performance of the entire service (e.g. disorientating layout, unwelcoming environments, unclear information, unpractical healthcare settings, etc.) [12]. Indeed, when social aspects are left at the end of the design process, there are no tangible results on individuals well-being and it can even generates extra cost with time waste and disabling situations [11]. Hence, a more holistic approach is needed to integrate the human factors to the design process providing a real impact on the healing performance of the buildings, linking different skills and needs [13].

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In this regard, Design for All (DfA) strategy, was defined to satisfy the unexpressed needs of the greatest number of people, derived by the society transformation over the last decade (e.g. growing of aging level and people with impairments) [14, 15]. The goal of this article is to explore how DfA can be applied into the design process, in relation to goals aimed at satisfying different users' needs. Attention will be placed on healthcare facilities where a plurality of users with different needs interact in these spaces (patients, clinicians, technicians, visitors, etc.), characterized by a number of functions being carried out in the same location [11, 12]. Two different case studies of healthcare facilities will be analyzed to highlight both the *design process* and *design solutions* in relation to DfA. The article expresses how this strategy can be used to enhance inclusive design of buildings, providing positive outcomes on users such as usability, well-being and social inclusion.

2 Design for All Strategy

DfA is a design strategy, which aims to social inclusion and uses' well-being. This strategy presents a more holistic approach thinking about individuals, which are considered in the design project for their needs and wishes, instead for their abilities or disabilities. The official definition of DfA was provided in the Stockholm Declaration as the 'design for human diversity, social inclusion and equality' [14] by the EIDD—Design for All Europe, a European network, founded in Dublin by the designer Paul Hogan in 1993 with the name of European Institute for Design and Disability.

The evolution of disability concept contributes to define DfA strategy. Indeed, disability is currently defined by the ICF [2] as the interaction between different factors: body (function and structure), activity, participation and context (environmental and personal factors). This means that it refers to a universal human experience since all individuals can be permanent impaired (e.g. people born blind), temporary impaired (e.g. age, pregnancy, broken limb) or situational impaired, considering the relation among health condition, built environment and social factors (e.g. negative attitudes, inaccessible transportation and public buildings, and limited social supports) [16]. Starting from this assumption, DfA strategy shifts the concept of 'disability' from a *medical model*, which focuses on 'special needs' of categories of people with disabilities or impairment, to a *cultural and social model,* in which the attention is focused on all people needs [17] and people with impairments are considered as experts, with knowledge about disabling and enabling environments [18]. In this regard, the experience of users is meant as not just related to physical or perceptive conditions (accessibility), but also cognitive, sensory, and social ones for ensuring their well-being [19].

3 Achieving Inclusive and Healthier Environment Through Design for All Strategy

The following paragraphs describe how to integrate DfA within the design process and solutions for achieving inclusive environments.

3.1 Design Process: Users' Involvement

The Stockholm Declaration specifies that DfA "requires the involvement of end users at every stages of the design process" [14]. The active involvement of final users is one of the key aspects applying DfA strategy. Users' needs and wishes should be considered in designing and evaluating buildings from the beginning of the design process, in order to prevent further changes [19, 20]. Indeed, when social aspects and usability problems are addressed after construction, there are no tangible results on individuals' well-being, furthermore it is time consuming and it can even generate disabling situations and extra-costs [21]. Following this perspective, DfA suggests that the design project development should be participatory, through a dialogue among actors, from the decision-makers to the final users [22]. All the experts in each discipline should be involved at each phase of the process (e.g. understanding of needs, design, evaluation, business-manufacturing). For instance, in healthcare environments clinicians might lead on the initial clinical research, but all other members of the team (design, business, administrative ones, etc.) take part in the process [23]. At the same time, the final users are considered as experts, because their experience is crucial to know their needs and wishes, to be transformed into actual design solutions (i.e. perception of the space by blind people) [18]. Therefore, designers are invited to consider multisensory experience of different users to improve the quality of the space.

3.2 Design Process: Users' Activities and Context

Both ICF model [2] and Ergonomics [14, 17] consider that the psychophysical characteristics of users are strictly related to the environment. Starting from this assumption, DfA adopts the same concept in a larger scale of the human diversity. Indeed different studies on DfA take into account the relation between human *activities* (e.g. overcome distance, orientate, concentrate, relaxing, etc.) and potential *users' characteristics* (e.g. age, gender, culture, abilities, disabilities, etc.) in different circumstances of the *built environment* (e.g. outdoor spaces, entrance, horizontal circulation, rooms, toilets etc.) [21, 22, 24–26]. In this regard, actions of people and their needs are constantly placed in relation to the context, representing the socio-spatial backdrop in which an activity may occur. They are also called 'activity settings' [27] or 'stages of a travel chain' [24], which usually are identified as: arriving at or approaching a

building; entering a building; circulating through the building; interacting with the main building facilities. In line with this, Luigi Bandini Buti has described how DfA was introduces for designing a refreshment area, considering different circumstances of the space and related users' activities: approaching (choosing the facility, parking, reaching the entrance); entrance/welcoming (using doors, wishes of the users, how to choose in food facilities); using restaurants and bars (eating and drinking, using seats and tables, garbage collection); etc. [26].

In the context of healthcare facilities, where tasks considerably vary in relation to different spaces [12], DfA strategy can be integrated to improve human experience of users. For instance, in waiting rooms it is fundamental to consider different aspects of the built environment related to the action performed in that space: how the patients will be greeted; which will be their first view; how patients and visitors will spend time during waiting; how will be the environmental conditions perceived by people waiting (e.g. temperature, acoustic, light, etc.); how will be the admission and administration procedures; which kind of seating can be more comfortable during waiting to fit different users' needs [28]. In this regard, the image shows the variables to consider during the design process following DfA strategy, structured on healthcare facilities design, such as hospitals (Fig. 1). In the case studies' descriptions, environments and users' activities will be constantly related to their needs.

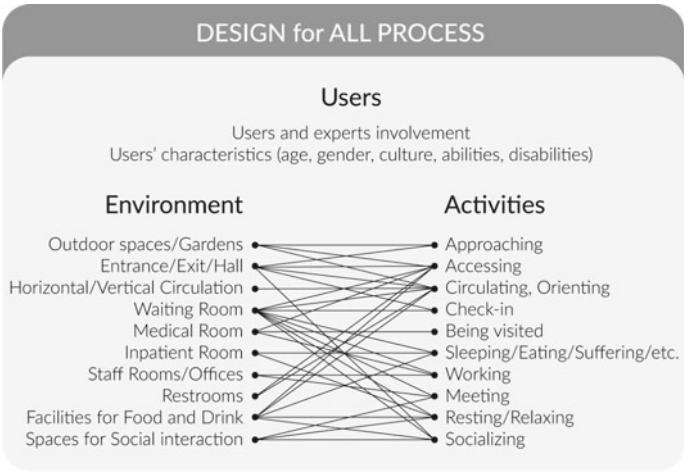

Fig. 1 Variables to consider in design process according to Design for All strategy: users' involvement and characteristics; environmental elements; human activities. *Source* authors. Study part of the doctoral research work in progress by Erica Isa Mosca at Politecnico di Milano entitled "Design for All AUDIT (Assessment Usability & Inclusion Tool). A performance-based tool to evaluate quality of healthcare environments for different users"

3.3 Design Solutions: Principles and Goals of Universal Design

While DfA focuses more on the design process, theoretical basis for the application of the design strategy are given by Universal Design (UD) [29, 30], which is a discipline developed in USA, that shares with DfA the same objectives of considering design for and with 'diversity' of users [15]. UD defined *7 Design Principles* to support the practical application of the strategy: Equitable use, Flexibility in use, Simple and Intuitive use, Perceptible Information, Tolerance for Error, Low Physical Effort and Size, and Space for Approach and Use [31]. In this sense, UD provides a more pragmatic and operative support to designer; however the risk is to apply its Principles as guidelines through a prescriptive approach, instead of proposing design solutions based on real people's needs [22]. Therefore, UD Design Principles should be used only together an in-depth analysis of the users' needs, in order to understand in which circumstance they can support the designer.

Steinfeld and Maisel [32] highlighted that UD should take into account also psychological and social elements, over human performance and sensorial factors already included by the UD Principles. In this way, they can cover all the outcomes of the environment on users. For this reason, the Center for Inclusive Design and Environmental Access (IDeA Center) proposed the *8 Universal Design Goals* [32, 33]:

1. Body fit—accommodating a wide range of body sizes and abilities.
2. Comfort—keeping demands within desirable limits of body function and perception.
3. Awareness—ensuring that critical information for use is easily perceived.
4. Understanding—making methods of operation and use intuitive, clear, and unambiguous.
5. Wellness—contributing to health promotion, avoidance of disease, and prevention of injury.
6. Social integration—treating all groups with dignity and respect.
7. Personalization—incorporating opportunities for choice and the expression of individual preferences.
8. Cultural Appropriateness—respecting and reinforcing cultural values and the social and environmental context of any design project.

The UD Goals actively sought to address the intersection of human performance (Goals 1–4) and social participation (Goals 5–8), where wellness (health) represents a bridge goal that address both themes [25].

4 Case Studies: Design for All in Healthcare Design

Two case studies of healthcare facilities, a hospital and a hospital's healing garden are analyzed to show the application of DfA principles in practice concerning both the indoor and outdoor environments. In the first one, DfA strategy is applied during the design of a new building, while in the latter DfA is used to renovate part of the architectural environment.

The current analysis describes for both projects the way DfA was introduced from the beginning of the *design process*. In addition, for each case study, DfA *design solutions* are described highlighting the relation between goals and healing outcomes on users (Tables 1 and 2) ensued by the application of the strategy in the design of the space.

4.1 St. Olavs Hospital

St. Olavs Hospital in Trondheim, Norway, was the winner of both the Innovation Award for Universal Design in 2014 and of the category for Architecture and for Landscape. The hospital is characterized by an inclusive architecture that emphasizes the human scale and experience from different perspectives, rather than just on

Table 1 Comparison between goals, design solution adopted in the case study and healing outcomes. St. Olavs hospital

Goals	Design solutions	Healing Outcomes
Cultural appropriateness	In depth analysis of users' needs End-Users survey Experts collaboration	Understanding users' needs in different circumstances
Social integration	Hospital square	Improving sense of community
Body fit	Entrance with no chance in level Entrance integration of ramps and stairs	Decreasing fatigue, Improving usability, functionality and equal use
Comfort Wellness Body fit	Healing garden Training path for wheelchair	Improving perceived quality Improving overall wellbeing
Understanding Awareness Wellness	Corridor's windows	Improving orientation, Improving wellbeing Decreasing stress
	Ward layout	Improving work performance Communication between staff and patients Perceived safety-security, privacy

Table 2 Comparison between goals, design solution adopted in the case study and healing outcomes. Grenville ward garden

Goals	Design solutions	Healing outcomes
Cultural appropriateness	Users involvement in garden decision making process, Experts collaborations	Understanding users' needs in different circumstances
Body fit Wellness	Specialized handrails Zero step entry Flush paved surface Raised planters	Improving usability and equal use Decreasing fatigue Improving performance in gardening activities
Personalisation Social Integration	Flexible seating	Socialization and privacy Improving overall wellbeing
Comfort Wellness	Water wall	Improving overall wellbeing Decreasing stress

functional aspects [34, 35]. St. Olavs Hospital represents an example of the ambitious agreement of the Norwegian Government, that in 2008 sets the goal that Norway should be characterized by universal and accessible design throughout by 2025 [36].

4.1.1 Design Process and Approach

The design's purpose was making the hospital as a social district accessible and open to the city, as a pleasant and welcoming place for patients, relatives, employees, students, scientists and, in general, for the community.

DfA was implemented at St. Olavs Hospital from the beginning of the design process, with guidance and thematic plans for every aspect of the design [34, 35]. In line with the DfA strategy, users' experience was considered fundamental in the decision-making processes from the first design phases. Indeed, designers assumed patients' point of view to understand how the physical surroundings can be designed to enable treatment. Furthermore, both patients and employees were involved through interviews to understand their different needs and perspectives: while patients explained their emotional needs, staff highlighted the functionality demands of their daily activities. In particular, user surveys of patients revealed three main wishes: privacy, visibility and availability of personnel, and accessibility [34, 35, 37].

One of the most important factors for the success of this project was the collaboration and teamwork of different experts across various disciplines, such as designers, engineering, builders and groups of stakeholders. Following this approach, the landscape architects selected the plans in consultation with the Norwegian Asthma and Allergy Association [34].

4.1.2 Design Solutions

The hospital is an attractive gathering place for the citizens and it represents a medical district opens to the neighborhood. At the entrance of the two main buildings a square with benches and green areas (Fig. 2) is used by both the hospital's users and by the citizens, as a real public space of the city. The square supports pedestrian accessibility by slowing down the traffic in front of the hospital, improving walkability and social interaction.

The main entrance is completely accessible with no change in level. In addition, the staircase of the hospital used to access to an historical building, represents DfA application in a creative way, solving a challenging difference in height with a combination of a stair and a ramp that integrates form and function (Fig. 3).

Inside the hospital, the circulation is supported by big windows that provide natural light and open views, guaranteeing both a direct contact with outdoor space and supporting the orientation in corridors (Fig. 3). Furthermore, the wayfinding

Fig. 2 Square of the main entrance of St. Olavs Hospital, Trondheim, Norway. Credits: Erik Børseth, Ingvild Aarseth, St. Olav Hospital, Trond Heggem. Images retrieved from: DOGA website www.inclusivedesign.no

Fig. 3 Entrance of historical building and hall of St. Olavs Hospital, Trondheim, Norway. Credits: Erik Børseth, Ingvild Aarseth, St. Olav Hospital, Trond Heggem. Images retrieved from: DOGA website www.inclusivedesign.no

system uses a color palette associated to the furniture, in order to recognize different spaces (Fig. 3).

Regarding the space for care, during the design process patients highlighted the need of both privacy and available personnel. For this reason, each ward has been given a center with eight single rooms located off this. In this way, the patients sleep peacefully and employees have a better overview, improving the overall security [34].

The hospital includes different healing gardens stimulating the body and the senses. In particular, a training path for wheelchair users was designed for rehabilitation and it gives the opportunity to practice in private and safe surroundings [35]. Healing gardens are also used by patients to spend time with relatives and by the staff for having break, improving the overall satisfaction and wellbeing of the hospital users.

Table 1 highlights the relation among project goals (UD goals), the described DfA design solutions and healing outcomes on users ensued by the application of the strategy.

4.2 Grenville Ward Garden—Royal Cornwall Hospital

Grenville Ward Garden at the Royal Cornwall Hospital (Fig. 4), in Truro, Cornwall, United Kingdom, represents an intervention of renovation for the entire hospital that meets the needs of elderly post-operative patients, staff and visitors [38].

Before the new design proposal, there was no dedicated users and workers rest area available. Thus, the purpose was to create a series of therapeutic and inclusive environments for users, therapists, staff, and visitors (Fig. 4).

Fig. 4 Grenville Ward Garden Hall and design sketch. Truro, Cornwall, United Kingdom. Credits: Michael Westley, Images retrived from: Westley Design ltd website www.westleydesign.co.uk and https://universaldesigncasestudies.org/

4.2.1 Design Process and Approach

The design aimed to produce a suite of outdoor 'rooms' with varying multi-sensory opportunities for patient interaction, rehabilitation, and recreation appropriate to the elderly users and visitors [38, 39]. The hospital staff also required a rest area with a designated degree of separation from the patient area; hence, the 'room concept' was applied to the overall design [40]. The result is an inclusive and therapeutic garden supporting the rehabilitation purposes of the Grenville Ward Hospital clinical program (for post-operative elderly care), as well as welcoming the wider hospital community.

Working closely with staff rehabilitation specialists, the garden was designed by involving site users, clinicians, and care professionals. Furthermore, the collaboration between the hospital staff and hospital management client team facilitated an inclusive design consultation process [39, 40]. The staff and patients were involved in the garden-making process, they participated in planting workshops and watched the artist produce sculptural elements for the garden on–site, creating a sense of ownership.

The garden was designed to be an inclusive place, taking into account different users' needs. Patients can take part of the welcoming outdoor environment either as an active treatment venue or as a place of respite and general relaxation. They can both enjoy the view from inside or go outside through beds, chairs or using waling aids [39].

4.2.2 Design Solutions

Different experts shared their interdisciplinary knowledge for the design of a range of furnishings to respond to the specific needs of the Grenville Ward. In particular, Westley Design architecture office collaborated with furniture designers, metal artist, hospital arts' coordinator, staff physiotherapists and occupational therapists [40]. Some examples of inclusive design solutions developed to improve the usability are specialized handrails, installed in the garden for use in mobility therapy programs, articulating the subspaces along the length of an otherwise rectilinear courtyard; the design elements are also useful at all times for multiple types of users. In order to promote easy and equal access to the space the pavement has no chance in level and flush paved walking surfaces are used. Raised planters and raised beds are installed throughout the garden for guaranteeing to people with reduced mobility or using wheelchair to interact with plants [38]. Flexible seating options to encouraging socialization or allowing privacy are used and these areas are sheltered with pergolas. Regarding perception's aspects, plantings were chosen to appeal to multiple senses and a water wall, used to separate the garden into staff and patient spaces provide privacy and it can be viewed and listened to by all users ensuring therapeutic effects.

As a result, after completion the use of the garden increased of 150% [40], transforming the paved courtyard, used as a smoking area by staff, to an high quality therapeutic courtyard garden for staff, patients and visitors.

5 Conclusions

The current study described the characteristics of DfA strategy, which can represent a valid proposal to stress the impact on both social aspects and healing performance of the service. This inclusive approach places the experience and perception of the person at the center of the process and it studies their needs and wishes closely. Furthermore, it promotes holistically the participation of different actors (e.g. designers, clinicians, client, workers, final users, etc.) with various knowledge and expertise in the design project.

The study provides descriptive information to integrate DfA considering the management of the design process and practical solutions adopted in relation to goals for satisfying users' needs. Two case studies of healthcare facilities have been used as examples to highlight how Design for All can raise positive outcomes on users through a more inclusive and healthier environment. Further research can follow applying the same method of analysis, in order to collect more evidence about the impact on users' well-being by the application of this strategy.

Thus, as described in the case studies, when DfA is integrated from the first stages of the process, as a care-oriented approach, it can influence on the physical, sensory, cognitive and social well-being for the greatest number of people.

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