

HOW TO DO IT

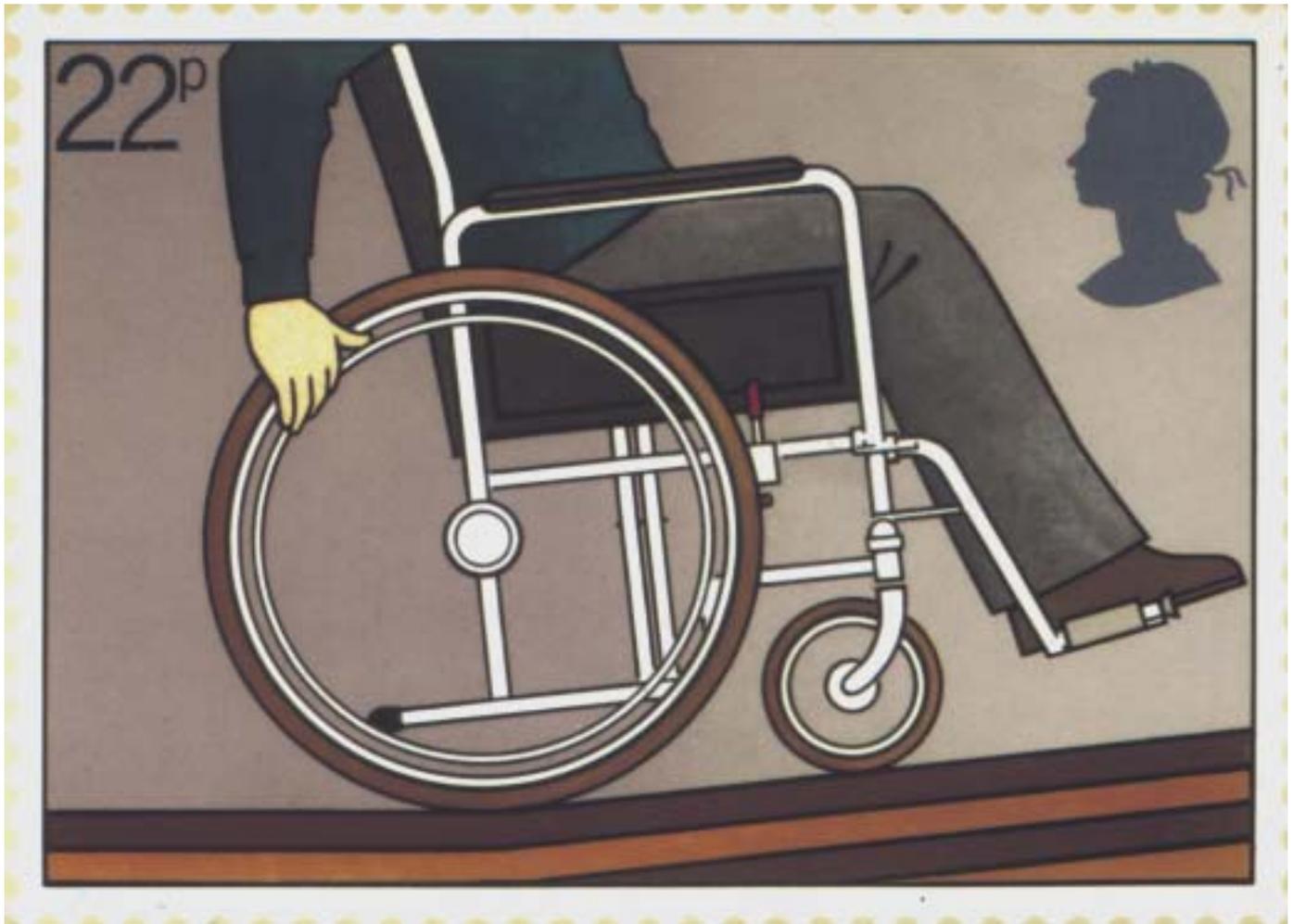


Figure 1 The ubiquitous wheelchair, shown here on a British postage stamp

INTRODUCTION

Wheelchairs are a common sight, especially in hospitals. Indeed, there are about 750 000 wheelchair users in the UK, out of a population of nearly 60 million, and they even feature on one of our postage stamps (Fig. 1). Although £90 million is spent each year on wheelchair services, some chairs are in poor condition (Fig. 2). Wheelchairs injure occupants, sometimes fatally. Attendants may also sustain injuries. Some patients develop neurological impairments as a result of using their wheelchairs. And many of these injuries and impairments are preventable.

Cerebrovascular disease is the most common neurological condition leading to wheelchair use (25% of wheelchair users have had a stroke). And many other people with neurological dis-

orders spend time in a wheelchair: for example, those with spinal injuries, multiple sclerosis, polio and muscular dystrophy. We believe that the assessment of neurological patients who use wheelchairs is incomplete without examining their wheelchairs. This is a simple procedure taking usually only a few seconds, and many defects may be easier and more helpful to correct than the patient's neurological impairments.

In this article we will consider manual (not powered) wheelchairs and focus on physical problems (not the social and psychological aspects of wheelchair use).

WHEELCHAIR TYRES

Traditionally, wheelchairs in hospitals and care homes had solid rubber tyres. Although, these

Examine a wheelchair

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(a)



(b)

Figure 2 (a) a new wheelchair compared with (b) a neglected hospital wheelchair. Note the absent foot plates and damaged arm rest. The legs are bandaged together. Figure 2a courtesy of Carters (J&A) Ltd.



Figure 3 The brake mechanism – a metal plate is applied to the tyre rim.



Figure 4 Secondary brake failure – if the tyre is flat, the brake does not work.

were robust, they were heavy and gave a bumpy ride. But for decades now, most wheelchairs have had pneumatic tyres. Air is light and inner tubes are cheap. However, the tyres deflate and may puncture. If the tyres are not fully inflated, the wheelchair will be hard work for the occupant to propel or the attendant (who may be old, have angina or chronic airways disease) to push. Even with fully inflated tyres, pushing a wheelchair can be hard work. If one tyre is less inflated than the other, the chair is difficult to steer and will veer to one side. Wheelchairs with pneumatic tyres are equipped with a pump. However, it cannot be assumed that the occupant will know how to inflate a flat tyre. We found that many elderly women did not know how to use a pump: in the days of more rigid sexual stereotyping, it was the man's job to maintain the pressure of the bicycle tyres and many elderly women never acquired this skill.

Tyres on new wheelchairs are now made either from solid lightweight synthetic materials that do not need inflating and do not puncture, or they have a cellular insert made of a rubber compound. Although they are initially more costly than pneumatic tyres, they are much easier to maintain, and potentially safer (but the ride is not quite as comfortable).

WHEELS AND CASTORS

Most wheelchairs have four small wheels (attendant propelled), or two large wheels at the back and two castors at the front (self-propelling). Castors should be free running and have a smooth action. A drop of oil is sometimes required. Large rear wheels have metal rims so the occupant can propel the chair. These rims can become loose and the central nut may need to be tightened. The metal may erode, causing

damage to the palms; in time it may need to be replaced. It is important to make sure that clothes and any blankets are tucked away so they do not catch in the wheels.

BRAKES

Most wheelchairs have a simple braking mechanism, whereby a metal plate is applied to the outer rim of the wheel or tyre (Fig. 3). If the tyre is not properly inflated, the brake will be ineffective (Fig. 4). This is potentially hazardous: if the brakes do not work, the wheelchair will move when the user is transferring in or out of the chair. Brake failure is a common cause of falls. These falls can be serious: patients falling from their wheelchairs may break their hips or fracture other bones. Some sustain head injuries, others are bruised or lacerated.

Primary brake failure occurs because of loose nuts. Always check the brakes by applying the brake lever and ensuring that the brake plate presses firmly against the outer rim of the tyre. If the brake is effective, the wheelchair should not move when pushed.

Wheelchairs are usually supplied with a spanner so that loose nuts can be tightened. If a hospital patient's wheelchair is unsafe, contact the occupational therapist who will be trained in wheelchair safety and maintenance.

SEATS AND CUSHIONS

The original wheelchairs were simply conventional wooden chairs with wheels attached (Fig. 5). They permitted people to travel short distances. With the advent of the railways and the fashion for spas, folding chairs were developed. This meant that the comfort of the seat was sacrificed for utility: wooden seats were replaced by canvas, which was light and could



Figure 5 Examples of early wheelchairs when wheels were merely fixed to standard domestic chairs.



Figure 6 Torn back canvas.

be easily folded. Unfortunately, canvas is much less comfortable. Those who spend long periods in wheelchairs are at risk of pressure sores affecting the ischial tuberosities. Indeed, in the USA, pressure sores resulting from wheelchair seating are now more common than bedsores. Wheelchairs are not good places for people to spend any length of time, but many nursing home residents spend hours just sitting in their wheelchairs.

Over time, the canvas seat will sag and may tear. The back canvas is also prone to wear and tear (Fig. 6). The rubberized canvas seat should be cleaned weekly: mild soap and water, or alcohol wipes are effective. Other types of upholstery include cloth and leather. Materials are available in a large range of colours to make the chair more attractive and personal.

All wheelchairs should have a seat cushion to increase comfort and reduce the risk of sores. In the UK most chairs have a simple polyurethane foam or latex (Dunlopillo) cushion. They are cheap (£8 for a standard polyurethane foam cushion). They have a plastic coating that can become uncomfortable, especially in hot weather. The plastic cover may be pierced by zips and



Figure 7 An arm rest gives comfort and reduces the risk of compression neuropathy.



Figure 8 Older wheelchair with eroded armrest and exposed bolt.



Figure 9 How to fold a wheelchair. Lifting the centre of the canvas seat reduces the risk of finger trapping.

other sharp objects. In time, the foam becomes compressed and needs replacing (usually every two years, but more often in a frequent wheelchair user). Urine can also destroy the foam in cushions. Always inspect the cushion for loss of bounce.

Other types of cushion are available: gel cushions adapt to the body's contours and distribute the user's weight over a wider area. They are heavy and thick, thus raising the occupant. This has implications for the position of the footplates (see below). RoHo cushions are filled with air and consist of inflated digits. They too raise the patient to a higher level. Special adaptations include split cushions to allow insertion of a urinal. The occupational therapist or local wheelchair centre will advise on the range of specialist cushions available.

ARM RESTS

Arm rests support and give comfort to the arm, and may reduce the risk of compressive neuropathy in those who spend long periods in their wheelchair (Fig. 7). The design has improved: older chairs had a bolt under the foam, which became exposed with prolonged use, causing lacerations to the arm (Fig. 8). The arm rests of new models are covered by plastic which should be inspected for tears.

Armrests are of different lengths: full length, desk length (to allow close access to desks and tables), flip-up and detachable. The detachable ones allow the user to transfer sideways on and off the wheelchair seat. Make sure the armrest can be removed. Otherwise, the user may have to rely on someone's help rather than being able to transfer independently. The two slots into which the armrest fits are not always easy to align, so re-inserting the armrest can be tricky.

Those who are not familiar with wheelchairs (health professionals as well as lay people) may not know how to fold and open a wheelchair. It is common for wheelchair neophytes to pull out the arm plate (one of which is at each side of the occupant) in a vain attempt to fold the chair. The correct way is to lift the centre of the canvas seat (Fig. 9). A fact sheet is available from the Stroke Association, which explains how to handle a chair, how to negotiate stairs and inclines, and also gives safety tips.

FOOT RESTS

In many hospitals, no one is responsible for wheelchair maintenance and safety. We have found that many wheelchairs are in a state

of neglect. A common problem is missing footplates. This means that the unfortunate patients have to try and keep their legs extended while being pushed. Sometimes, the foot becomes trapped under the front of the wheelchair.

Footplates should be of the optimum height for each patient. If they are too high, the user's legs will be flexed and there will be increased pressure on their buttocks. If the footplates are too low, pressure will be transmitted to the back of the legs. A spanner can be used to adjust the plates. Footplates should swing laterally and latch onto the frame to allow the user to stand up (stepping onto the footplates may cause the chair to tip forwards and result in an injurious fall). In some types of wheelchair, the retracted footplates get in the way of the brakes.

FRAMES

One of the most important advances in wheelchair technology has been the development of lightweight frames made of stainless steel, chrome, aluminium, titanium and other materials. The clinician should inspect the frame for cleanliness. The cross sections of the frame should be checked for damage or loose linkage.

LAP STRAPS

To reduce the risk of falling out of the chair, pelvic or waist belts can be fitted. They also help the user to maintain a good postural position in the seat. They should be used with caution: there are reports of patients slipping down and becoming asphyxiated by the straps. Check straps for signs of wear and cleanliness.

THE DIMENSIONS OF THE WHEELCHAIR

If the chair is too large, the occupant may move excessively when in transit. He or she may not be able to keep their feet on the footplates or sit back properly (unless padded at the back). On the other hand, if the wheelchair is too small, hips and thighs can be bruised or abraded. If the depth of the seat is too shallow, pressure may be transmitted to the back of the legs. A narrow back canvas can cause pain in the shoulder because of pressure from the handles. A low back canvas may cause back discomfort.

THE WHEELCHAIR OCCUPANT

To complete the assessment, it is important to ensure that the user has not developed any physical complications from wheelchair use. In the USA, there are over 35 000 wheelchair-related

injuries each year that are serious enough for the patient to go to an emergency department. 12% require admission. Many more patients have less dramatic complications. In the UK, the Medical Devices Agency received 1388 adverse incident reports on wheelchair (and other seating) related incidents in 2002. There were 12 fatalities. Wheelchairs are potentially dangerous items of equipment. Therefore check for:

- Pain – 60% report neck pain after becoming a wheelchair user. Shoulder pain is common too, affecting 50% of wheelchair users with spinal cord injury. It is related to wheelchair propulsion and transfers. Two-thirds of long-term polio wheelchair users have arm pain, mainly because of over-use. Over 50% of wheelchair users with polio develop osteoarthritis in the hand. In one in eight, the arthritis is moderate or severe. Propulsion by the hand rim can lead to repetitive strain injury to the arm. This in turn may result in further impairments and disability.
- Nerve palsies – paraplegic wheelchair marathon racers are prone to ulnar lesions due to pressure on the deep motor branch. Wheelchair racers are also at particular risk of median and radial nerve injury. Wearing gloves and handling the wheelchair in the correct way may prevent these injuries.
- Pressure sores – these mainly affect the buttocks and sacrum, areas often overlooked on routine physical examination of the neurological patient.
- Bruises, lacerations, strains, sprains and fractures – these result from wheelchair component faults and from falls. Users may tip backwards, sideways or fall forwards – particularly if they are being helped down steps or ramps by an inexperienced assistant. Wheelchair fallers tend to be older and many have had a stroke – particularly those with apraxia or cognitive impairment. Two-thirds of young people with Duchenne muscular dystrophy sustain lower limb fractures as a result of wheelchair falls.
- Burns – smoking is the cause of most burns in wheelchair users. Special flame retardant blankets are used in some care homes and hospitals to reduce the risk.

THE WHEELCHAIR ATTENDANT

People helping wheelchair users may themselves be injured by the chair. We have found

that shin injuries are the most common, caused by the two tipping levers on the back of the chair (these are used to tip the chair backwards when negotiating steps). Also, fingers can easily become trapped between the seat canvas and the armrests. Carers can trap their fingers when erecting or dismantling the chair and clinicians must check that carers are using the correct technique (Fig. 9). Other injuries to attendants include foot bruising as a result of loose foot rests and injuries caused by getting caught in the wheels.

RECOMMENDED READING

Mulley GP (1989) Standards of wheelchairs. *British Medical Journal*, 298, 1198–9.
Stroke Association (2003) Stroke and wheelchairs. London, Stroke Association (factsheet).

USEFUL ADDRESSES

A list of all NHS wheelchair centres in the UK can be found on the National Wheelchair Managers' Forum website at <http://www.wheelchairmanagers.nhs.uk> or by calling NHS Direct on +44 (0) 845 4647.

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WHEEL CHAIR CHECK LIST

- Are the tyres properly inflated?
- Are the wheels and castors free running?
- Is the metal rim of the wheels tight and undamaged?
- Do the brakes work?
- Is the cushion intact, and suitably bouncy?
- Is the back canvas clean and intact?
- Are the arm rests appropriate and undamaged?
- Are the footplates at the right height and undamaged, do they swing open correctly?
- Is the frame clean and intact?
- Are any lap straps clean and undamaged?
- Is the chair the right size?