



# Chronic Unilateral Neglect from Focal Meningoencephalitis Lesions in an Immune-Compromised Hemodialysis Patient

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**Abstract:** Unilateral neglect (UN) is a disorder associated primarily with right-brain damage; it causes individuals to behave as if the contralesional half of their world has become unimportant or has simply ceased to exist. This is the first known case study to describe and measure UN caused by an infectious process, meningoencephalitis. The patient was immune compromised as a result of antirejection drugs following a kidney and pancreas transplant, as well as from a baseline vulnerability common to patients with hemodialysis. She was reassessed serially during hemodialysis treatments over 12 months and demonstrated improvement in some measures of UN but not in others. UN is a recognized nursing diagnosis and can be assessed, treated, and researched by nurses. Neuroscience nurses need to better understand and investigate UN to improve their own practice and the practice of other specialties.

## Unilateral neglect

*Unilateral neglect* (UN) is a disorder that causes individuals with brain damage to behave as if one half of their world—the half contralateral to the damage—has become unimportant or ceased to exist (Mesulam, 2000). It is not a sensory or motor disorder of seeing, hearing, or moving, but instead is a disinclination to look, detect, explore, or interact with the contralesional world (Mesulam). Affected patients may fix their head or gaze to one side; dress, groom, and protect only one side of their body; eat food from only one side of the plate; ignore or collide with people and objects on the neglected side; and even deny ownership of their own contralesional limbs (Parton, Malhotra, & Husain, 2004; Robertson & Halligan, 1999).

UN is a heterogeneous syndrome with several subtypes, and it is possible that many distinct disorders have been inaccurately lumped together under this single label (Halligan & Marshall, 1994). There is a growing consensus that no single mechanism accounts for the full range of signs and symptoms (Buxbaum, 2006; Danckert & Ferber, 2006; Manly, 2002; Stone, Halligan, Marshall, & Greenwood, 1998). It appears that impairments of several different pathways converge to result in UN, each of which could exist singly without causing it (Parton et al., 2004). Also, it has been difficult to assign any

particular variations of UN to specific neuroanatomical loci (Buxbaum). However, UN appears to be more common, more severe, and more permanent after damage to the right brain than after damage to the left hemisphere (Ringman, Saver, Woolson, Clarke, & Adams, 2004).

## Meningoencephalitis

Infectious meningoencephalitis commonly causes a course of abrupt fever and headache that progresses to impaired general mental status and ultimately to focal seizures and other neurological signs and symptoms (Chaudhuri & Kennedy, 2002). In later stages, it is easily misdiagnosed as, for example, a combination of a stroke with an underlying infectious process such as pneumonia (Townend, Hanson, Sturm, & Whyte, 2005).

Focal lesions of meningitis and encephalitis can cause higher-order neurological impairments. Miotto (2002), for example, reported a case of a patient with chronic anomia caused by meningoencephalitis. But there are no known examples in which UN was explicitly identified in such a patient. One patient with meningoencephalitis, described by Fujimoto and colleagues (2002), did have a positive Prévost's sign, with both eyes and the head fixed toward the right. This ipsilesional deviation of the head and eyes is specific to UN (Berger, Pross, Ilg, & Karnath, 2006). However, the authors did not identify or further assess for UN, and the patient expired before any obvious clinical manifestations were noted.

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## Hemodialysis and Infection

Hemodialysis patients are prone to infection, and cases of bacterial meningitis have been reported in the literature (Fujimoto et al., 2002). These patients also have more bacterial infections than other patients, and their infections seem to progress faster and resolve more slowly than those of other patients (Leehey, Cannon, & Lentino, 2007). Infection is second only to cardiovascular disease as a cause of death among hemodialysis patients and is a significant cause of morbidity and hospital stays (Powe, Jaar, Furth, Hermann, & Briggs, 1999).

Several factors contribute to this vulnerability to infection. Uremia itself profoundly alters immune function and is worsened by secondary hyperparathyroidism, a frequent consequence of end-stage renal disease (Hörl, 1999). Malnutrition and excessive iron therapy, both common to hemodialysis patients, further impair the immune response (Hörl). Because hemodialysis requires prolonged vascular access and is performed in crowded outpatient centers (Centers for Disease Control and Prevention, 2001), microorganisms can be spread from patient to patient, particularly if nurses and technicians fail to use universal precautions (Jaber, 2005). Other causes of transmission include contamination or inadequate disinfection of reusable dialysis filters, leaks in filter membranes, and contaminated saline or dialysis solution (Fujimoto et al., 2002). The common process of disinfecting and reusing hemodialysis filters increases the risk of infection by 28% (Powe et al., 1999).

## Case Study

The case study that follows describes a patient with chronic UN caused by right-hemisphere lesions of meningoencephalitis. The patient was hospitalized several times during the 12 months after her original infection and was assessed during inpatient hemodialysis treatments to track her progress.

### Emergency Department Visit

E. R. S., a 37-year-old female, was well known to the emergency department (ED) when she presented with a migraine just after midnight late in 2006. She had poorly controlled type 1 diabetes mellitus and had visited the ED 15 times during the previous 12 months. These visits were typically prompted by nausea resulting from poor glucose control or photophobic migraines; the normal course of treatment was symptom relief and a rapid discharge. The only apparent difference on this night was that she came directly from a friend's birthday party and appeared intoxicated. She had a known history of alcohol and drug abuse and was lethargic with slurred speech and impaired attention.

During triage, her nurse recorded a blood pressure of 222/120, a heart rate of 120, and an ear-probe temperature of 38.9 °C. Then, shortly after she was evaluated by the physician, she had a syncope episode and went into respiratory arrest. She was immediately intubated and a central line was placed, labs were drawn, and she was transferred to the intensive care unit (ICU).

### Inpatient Stay in the ICU

In the ICU, E. R. S. was evaluated, and her complex medical history was taken into account. She had never controlled her diabetes well and now looked about 20 years older than her actual age. She had retinopathy, peripheral neuropathy, restless leg syndrome, kidney failure, and chronic inflammatory demyelination.

E. R. S. had been on hemodialysis for 3 years before having a kidney and pancreas transplant in 2002. But a few months before her admission in 2006, her transplanted kidney failed and she resumed hemodialysis.

Since her transplanted pancreas was still intact, she was taking the antirejection drugs mycophenolate mofetil (Cellcept) and tacrolimus (Prograf). Because of her immune vulnerability, she was started on a precautionary regimen of acyclovir (Zovirax), vancomycin (Vancocin HCl), and ceftriaxone (Rocephin).

Meanwhile, her physician ordered a cerebrospinal fluid (CSF) culture, several serological studies, and a computed tomography (CT) scan of her brain. A lumbar puncture produced cloudy CSF with a white blood cell count of 189/ml and a differential of 98% eosinophils, 1% lymphocytes, and 1% monocytes. Her CSF glucose and protein were elevated at 73 mg/dl and 101 mg/dl, respectively. The CSF gram stain was negative, as were bacterial and fungal cultures.

Serological tests for West Nile virus and herpes simplex virus were negative. Blood cultures were negative after 5 days. Her serum white blood count was 7,800/ $\mu$ L but rose to 10,900/ $\mu$ L during the next 4 days. This prompted a check of her erythrocyte sedimentation rate, which was elevated at 38 mm/h, and the C-reactive protein level, which was also elevated at 2.5 mg/dl.

The CT scan of E. R. S.'s brain did not demonstrate any acute pathology, but it did show diffuse, generalized atrophy of white matter, particularly around the ventricles. This was consistent with her chronic demyelination and had changed little since last viewed on a magnetic resonance imaging (MRI) scan 7 months earlier.

After 2 days in the ICU, E. R. S. started having simple partial seizures in her left arm, dysconjugate pupils with the left larger than the right, and flaccid drooping on the left side of her face. Given this

progression, a magnetic resonance angiogram (MRA) and a diffusion-weighted MRI scan of her brain were ordered. The MRA showed no masses, occlusions, or other vascular abnormalities; however, the MRI showed considerably increased signals in the cortices of the right frontal, temporal, parietal, and occipital lobes (Fig 1).

Diffusion-weighted imaging (DWI) relies on the random movement of particles in solution to identify areas of tissue in which this random movement has been sharply reduced by a disease process. A series of magnetic pulses excite molecules, and, if a given molecule remains in one location, its signal increases. It will then appear brighter on the DWI than a molecule that has randomly moved away from its original position (Provenzale & Sorensen, 1999).

DWI is used extensively to diagnose strokes because there is less random molecular motion in ischemic tissue. The exact reason for this remains unclear, but it appears to be related to the disruption of metabolism, which, in turn, shuts down ion pumps in cell membranes. These events disrupt the normal ionic gradient across cell membranes and lead to an influx of water into the cells. The resulting cellular swelling, or *cytotoxic edema*, decreases the extracellular space and restricts molecular movement both inside and outside the cells. The subsequent dissociation of microtubules and other intracellular components increases the cytoplasmic viscosity and further reduces random motion (Schaefer, Grant, & Gonzalez, 2000).

DWI is also a reliable and robust tool for identifying lesions of meningitis and encephalitis because it outperforms other imaging studies and is especially useful for showing cerebral changes that correlate with clinical improvement (Tsuchiya, Katase, Yoshino, & Hachiya, 1999). In a recently reported case of West Nile encephalitis, DWI was the only imaging method that showed any cerebral abnormality (Agid et al., 2003).

Impaired molecular movement in meningitis and encephalitis may be due in part to microorganisms directly causing cellular metabolic failure that leads to cytotoxic edema (Tsuchiya et al., 1999). But it has also been suggested that the infiltration of nervous tissue by inflammatory cells increases the viscosity of the region and thereby reduces random molecular movement (Agid et al., 2003; Peng, Tseng, Liu, Li, & Huang, 2003)

Given the results of her DWI imaging and CSF tests, E. R. S. was diagnosed with infectious meningoenzephalitis. Although the pathogen was never identified, the differential count of white blood cells in her CSF suggested that it was bacterial. She remained in the ICU for 10 days and was given antibiotics and antiepileptics.

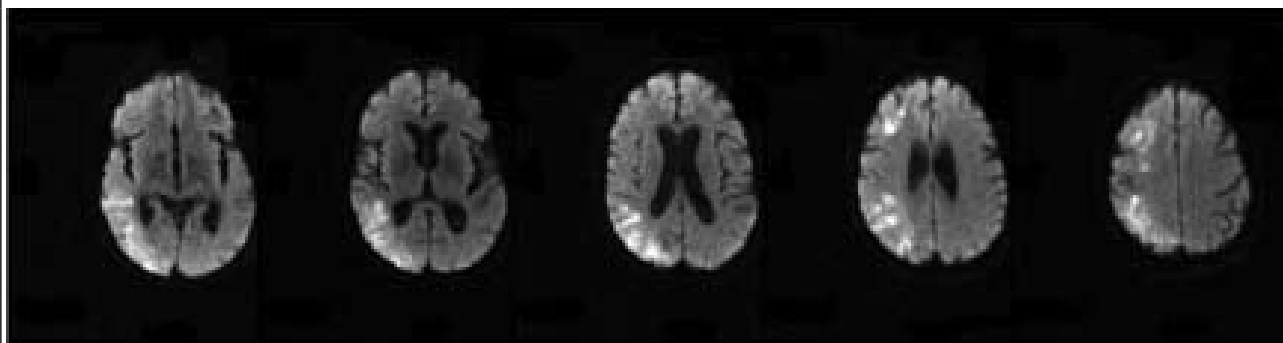
### Transfer to Neurorehabilitation

On her fourth day in the ICU, a physiatrist saw E. R. S. for a neurorehabilitation consultation. Among the physiatrist's observations was that E. R. S. had developed significant UN. This diagnosis was based on clinical signs alone—her head and eyes were fixed to the right, as if by magnetic force, and she ignored objects, people, and commands on her left side.

On her 10th day in the ICU, E. R. S. was stable enough to transfer to an inpatient neurorehabilitation facility that housed an integrated program consisting of specialists in psychiatry, nursing, occupational and physical rehabilitation, speech pathology, dietetics, and neuropsychology, all of whom collaborated in daily meetings and weekly conferences. Their chief goals for E. R. S. were restoration of left-arm strength and function, recovery of balance, amelioration of UN, improvement of affect, and resolution of bowel incontinence.

Nurses are the backbone of a rehabilitation center because they are with the patient throughout the day and night and interact across a variety of complex activities and settings. This is particularly important when assessing and addressing UN,

Fig 1. Diffusion-Weighted MRI Showing Areas of the Brain Affected by Meningoencephalitis



Note. Notice the presence of increased signal in the cortices of the right frontal, temporal, parietal, and occipital lobes.

which can vary significantly throughout the day according to a patient's wakefulness, motivation, and mood (Azouvi et al., 2006).

The occupational and physical therapy staff worked with E. R. S. on specific tasks and cued her to scan for leftward obstacles, dress leftward limbs, and groom her left side. The nursing staff augmented this training with further cuing and reinforcement throughout the day.

With E. R. S.'s UN in mind, nurses also implemented measures for safety and reorientation. They kept the left-hand bed rails up, placed important items on her right, and approached and addressed her from her right side. They also positioned her bed so that she could look out a large window on her right side—nurses use large windows to help restore a patient's regular sleeping pattern and sense of time, which can be lost after a neurological insult and lengthy hospital stay. If the bed had faced the other direction, E. R. S. would likely have been unaware of and unaffected by the window.

### Status at Discharge

E. R. S. was assessed comprehensively on the day of her discharge home from the neurorehabilitation unit. Even though she had been there only 8 days, she had improved substantially. Nonetheless, the staff believed that she would benefit from a longer stay. Unfortunately, E. R. S. had little social support from friends or family and displayed a surprising unawareness of her lingering deficits.

This unawareness of deficit, or *anosognosia*, frequently coexists with UN and is a cardinal feature of right-brain damage, particularly in patients with underlying neurological deficits (Appelros, Karlsson, & Hennerdal, 2007). So, although E. R. S. still needed to wear a brief for incontinence, collided with leftward objects, remained off balance, and needed assistance with activities of daily living, she was convinced that nothing was wrong and had begun refusing to participate in therapies.

Immediately before her discharge, E. R. S. was assessed with several UN tests. Her gaze had improved since her transfer to neurorehabilitation, but her eyes continued to make constant, spontaneous saccades to the right. She could read full words and full sentences but failed a line cancellation test, crossing through only the lines on the right side of the paper (Fig 2). When asked to pantomime brushing her hair, she did so only on the right side of her head. When asked to identify her left hand, she said "I know that it's my hand, it just doesn't feel like it."

### Status 4 Months After Discharge

E. R. S. was reassessed while on inpatient dialysis during a subsequent hospitalization 4 months after

**Fig 2.** Unilateral Neglect Demonstrated on a Line Cancellation Test



her discharge from neurorehabilitation. Her gaze was now free of rightward saccades, and she could point straight ahead. When asked to name 10 things in the room, she noted objects on both her right and left sides. When asked to pantomime grooming, she did so on both sides of her body. When asked to identify her left hand, she laughed and said that her boyfriend had constantly reminded her to use it during the last 4 months, and now she felt that she used it as much as she did before the infection.

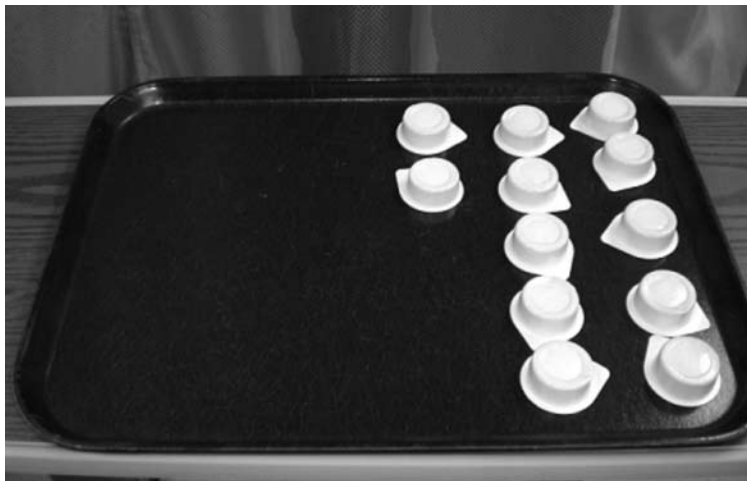
It appeared as though E. R. S. had completely overcome her UN. However, when she attempted another line cancellation test, she failed. This fact underscores the difficulty of assessing UN with paper-and-pencil tests because they are not always good indicators of everyday function (Rossetti & Rode, 2002). A patient may pass these tests despite functional impairment or, as in the case of E. R. S., may fail the tests but perform everyday activities normally.

To further investigate, E. R. S. was given a variation of the Baking Tray Task that required her to spread 12 peanut butter cups across a lunch tray as if they were cookies on a baking sheet (Tham & Tegnér, 1996). This test may be superior to paper-and-pencil tests because it reflects an everyday activity and has several possible correct solutions. Her performance was typical of someone with UN: she spread the cups uniformly, but only on the right side of the tray (Fig 3).

### Status 6 Months After Discharge

Six months later, E. R. S. was seen again while on dialysis and her progress was reassessed. She was appropriate with gaze, pantomime, pointing straight ahead, and naming objects in the room. She was aware of and claimed her left hand and stated that she now used it as much as she had before the infection. Once again, she demonstrated

**Fig 3.** Unilateral Neglect Demonstrated on a Modified Version of the Baking Tray Task



the presence of UN on a line cancellation test and a variation of the Baking Tray Task.

She was also given a version of the Fluff Test during which cotton balls were taped all over her torso and arms and she was asked to find and remove them (Cocchini, Beschin, & Jehkonen, 2001). She again demonstrated the presence of UN by removing cotton balls only from her right side.

### **Status 12 Months After Discharge**

E. R. S. was assessed a final time during inpatient dialysis 12 months after her discharge from neurorehabilitation. She did not show any outward signs of UN. Her gaze was straightforward, she ate from both sides of her plate, she named distant objects from all around the room, and she pantomimed grooming on both sides of her head. She claimed that she used both hands equally and that she functioned independently in shopping, catching the bus, and other complex activities.

E. R. S. was given a line cancellation test, and she passed it for the first time. Her search pattern was random and redundant, and she still seemed drawn to the right side of the page. But by the end of the test, she had correctly located and marked all of the lines on the page.

She was also given a version of the Baking Tray Task with a lunch tray and peanut butter cups. On this test, she continued to show the presence of UN but now did so in a manner that differed from her previous tests. Instead of neatly lining the cups in vertical rows on the right side of the tray as she had done before, she set them in two horizontal rows crammed into the bottom right corner of the tray.

This new grouping suggested a possible alteration in the reference frame of her neglect, so she was assessed further with the Star Cancellation Test (Wilson, Cockburn, & Halligan, 1987). This is a

popular test and is considered to be more sensitive than basic cancellation tests because its targets, small stars, are scattered among several distractors: letters, words, and large stars. E. R. S. demonstrated UN on the test. Surprisingly, she did so across a diagonal axis extending from the left bottom corner to the top right corner of the page rather than across the expected vertical axis (Fig 4).

Her search pattern and spatial memory were also noticeably impaired during the task. Instead of scanning the page systematically, her eyes wandered from one location to the next, and she circled several targets two and even three times.

### **Case Summary**

Although E. R. S. has improved over time, she continues to display some subtle forms of UN. It is difficult to ascertain how much these affect her everyday activities. According to her self-report, she is as functional now as she had been prior to the infection. But this report must be questioned because of her history of anosognosia. Her boyfriend and family may be able to accurately rate her actual impairment, but they have been absent from all of the assessment sessions and seem uninterested in participating.

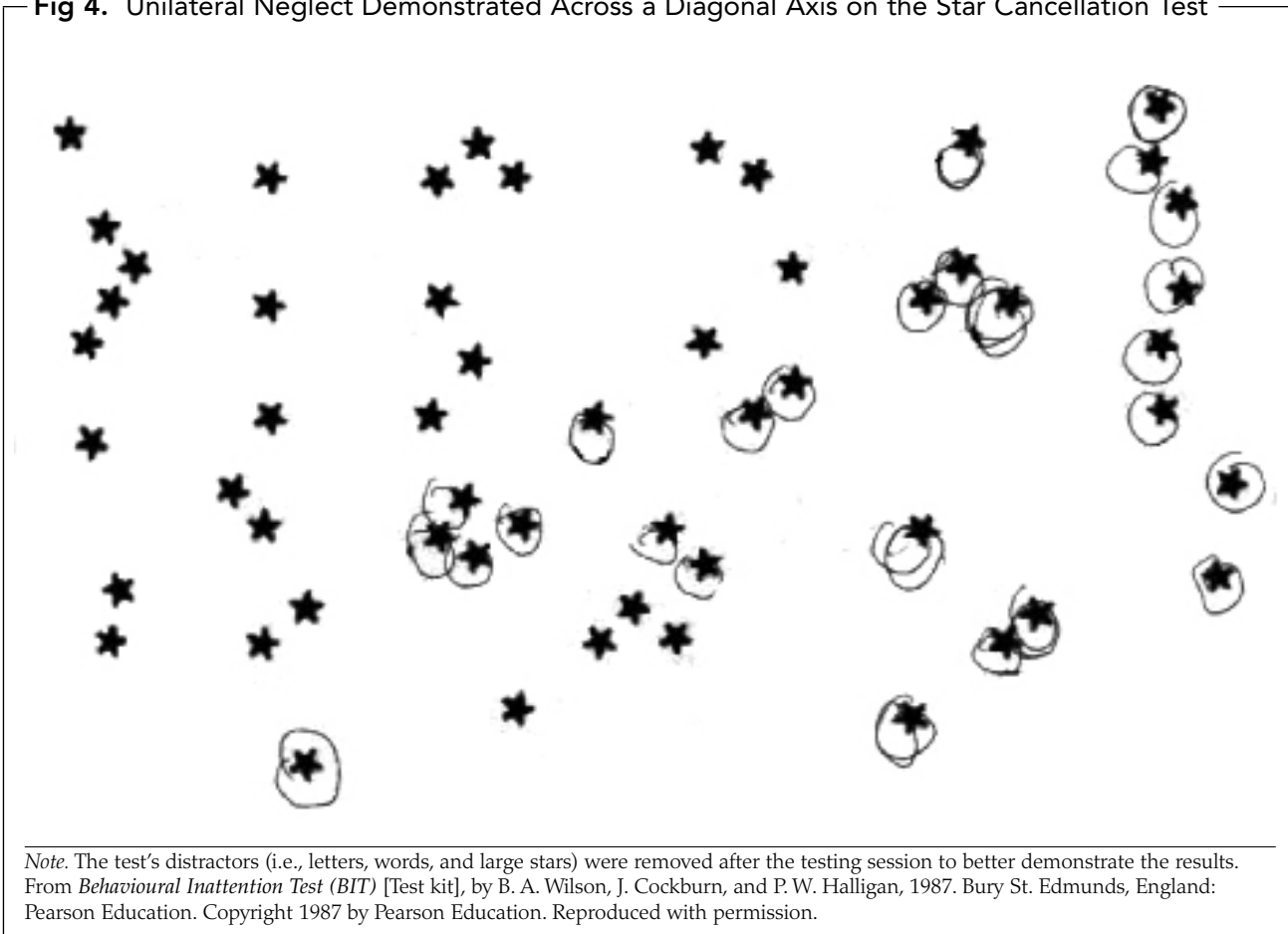
The fact that E. R. S. continues to show evidence of UN in a cancellation test and in a variation of the Baking Tray Task suggests that she may yet have spatial deficits that could interfere with everyday activities. Particularly telling are the impaired scanning and spatial memory she continues to display 12 months after the onset of UN. Although she now recognizes and feels ownership of her left arm, she did not remove cotton balls taped to it during a version of the Fluff Test. This, too, suggests lingering UN that may impair some of her everyday activities.

It is possible that E. R. S. has only subclinical UN (i.e., UN that manifests in testing situations but not in actual behavior). She did not show any signs of UN while she ate, ambulated, dressed, or pantomimed grooming. However, it remains possible that fatigue, stress, or distraction could exacerbate her subclinical UN and grossly impair her outward behavior.

### **Nursing Implications**

UN has been recognized as a nursing diagnosis since 1986 by NANDA International (McLane, 1987). This designation implies a primary responsibility of nurses for assessing, treating, and researching the disorder (Gordon, 1994). In addition, nurses are in an ideal position to identify, monitor, and address UN because they interact in a unique way with patients at various times, during a variety of activities, and in multiple settings each day.

Fig 4. Unilateral Neglect Demonstrated Across a Diagonal Axis on the Star Cancellation Test



Several nursing-specific interventions and outcomes are outlined in the *Nursing Outcomes Classification (NOC)* and *Nursing Interventions Classification (NIC)* references (Bulechek, Butcher, & McCloskey Dochterman, 2008; Moorhead, Johnson, Maas, & Swanson, 2008). *NOC* guidelines, for example, suggest outcomes that include a patient's heedfulness of the neglected side, coordination of movement, and self-initiated body positioning (Moorhead et al.). These outcomes might be accomplished with the help of several *NIC* interventions, including scanning training, cuing, environmental adaption, and family education, among others (Bulechek et al.). As with all neurological recovery, it is not always possible to distinguish spontaneous recovery from rehabilitation or restoration from compensation, but the *NIC* interventions are well-established practices that seem to contribute positively and can be individually tailored to each patient (Manly, 2002).

Nurses were involved in E. R. S.'s care from her ED triage through her follow-up assessments months later. Nurses in the neuro-rehabilitation center acted autonomously using both nursing diagnosis

and intervention along with cuing and reorienting E. R. S. while maintaining her safety and comfort.

UN remains a difficult disorder to assess, understand, and rehabilitate. This is particularly true when the etiology is uncommon, as it was with E. R. S. Neuroscience nurses need to become more informed about UN, not only to provide effective care, but also to contribute to the ways in which all specialists understand and treat the disorder.

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