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Technologic advances in psychiatric nursing

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Historically, mental health care and psychiatric nursing used little technology. Psychiatric care, even up to the last 2 or 3 decades of the twentieth century, had little use for gadgets. Diagnosis was made on the basis of careful interview and deductive logic. No reliable laboratory tests confirmed these diagnoses consistently. Treatment used talking and medications and environmental management to help patients make improvements in their symptoms.

When the author first started practicing in 1972, the technology used consisted of a small metal box with a few buttons and dials. It was located in the treatment room off the main hallway of the unit. There, rarely, the most intransigent of patients were taken. They were the patients who did not respond to the milieu, the talking, the group activities, or the medications. The team consisting of the physician, a nurse, an aide, and an anesthesiologist would administer a barbiturate and succinylcholine—and enough electric current to each temple to generate a grand mal seizure. A year later, the author was working in a different hospital, where electroconvulsive therapy was given to many patients. In a bright procedure room, depressed patients were scheduled every half hour or so for their procedure. With more neuromuscular blockade prescribed in the protocol at this facility, the seizures were less pronounced. From the procedure room, the patients were rolled into the recovery room, where two rows of patients recovered from their electroconvulsive therapy. Technology was not consistently embraced within mental health treatment.

Psychiatric care in the early twentieth century used mostly mechanical technology if any was used at all. Treatment before the discovery of effective psychoactive medications included restraint devices (eg, straitjackets, sheet wraps that were often wet, and leather restraints), baths, seizures produced

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by insulin or electric shock treatment, and barbiturate or soporific medications (eg, chloral hydrate and paraldehyde). The causes of mental illness were explored through history taking or psychoanalytic methods. At most, the technology of gross anatomic dissections of brains of mentally ill patients revealed a few things: The ventricles of patients with schizophrenia are larger than those of nonschizophrenic patients, and the brain itself is atrophied. Most brains came from individuals who had been ill for many years or who were elderly. It was difficult to sort to what degree these brain changes were explained by the disease alone.

Medications that improved symptoms (more than just putting patients to sleep) were discovered in the mid-twentieth century. Scientists then learned a great deal about the brain from animals [1], in which specific areas of the brain were destroyed, psychoactive medications were given, and behavioral manifestations that were eliminated or enhanced were measured. As a result of this information, combined with the pharmacologic and neurochemical knowledge at the time, scientists learned about the location and types of neurotransmission in the brain. Disorders in humans caused by known brain deficiencies, such as Parkinson's disease, suggested hypotheses about the mechanisms of action of drugs that created behavioral syndromes similar to the deficiency syndromes. This research culminated at the end of the twentieth century with the "decade of the brain," during which there was exponential growth in the understanding of the brain and technologies for understanding the brain.

At the same time, a major shift in the attitude toward psychiatric care, patients, and practitioners was occurring. Psychiatric symptoms were less stigmatizing to the patient. Families could point to the biology of the illness rather than to the "schizophrenogenic mother" or family. Psychiatrists could rejoin, with legitimacy, their colleagues in other specialties who primarily treated their patients with medications or surgery. Technology changed the lives of everyone involved in the mental health system directly and indirectly. This article describes some of the technologies available for research, assessment, and treatment, including a variety of imaging techniques, genetic explorations, medications, and alternative treatments. What these technologies mean for nurses working with the mentally ill is discussed briefly.

Imaging technologies

Several imaging technologies currently are used for assessment and research into the disordered functioning of the brain in mental illness, including structural neuroimaging and functional neuroimaging [2]. Clinical assessment using these technologies allows the clinician to rule out any malignant or neurologic diseases that may be altering brain function and causing psychiatric symptoms. Research using these technologies has confirmed many of the findings of earlier gross anatomy studies of brain

changes when people develop mental disorders. The advantage of using these methods is that brain research can be done in vivo early in the development of a mental disorder, before the patient receives medications and during and after the chronic course of the illness. Clinicians and researchers do not have to wait until a patient's death or perform dangerous surgeries to identify brain pathology.

Structural neuroimaging techniques include computed tomography (CT) scanning and magnetic resonance (MR) imaging. These technologies are noninvasive methods to examine the anatomy of the brain. CT [2] uses x-rays and computers to create a series of pictures of slices of the brain based on how much x-ray beam is absorbed by various brain structures. The more the tissue absorbs of the x-ray beam, the lighter it appears in the series of pictures. Cerebrospinal fluid appears the darkest, and bone appears the lightest; white and gray matter of the brain are the most difficult to distinguish. To enhance the ability to distinguish tumors or infection, iodinated contrast material may be given intravenously. Contrast materials may cause mild to severe adverse effects, ranging from a metallic taste in the mouth to nausea or joint pain to anaphylactic allergic reactions. The equipment used for a CT scan also may be frightening and requires at least a preparatory explanation of the experience or reassuring accompaniment during the procedure. Careful monitoring for adverse effects after the procedure is essential.

MR imaging uses a strong magnetic field to detect differential changes in electromagnetic energy released by brain tissues during the procedure to create a three-dimensional image of the brain [2]. The image that results from this procedure is clearer than that produced by the CT scan and better distinguishes between white and gray matter of the brain. The procedure itself is limited, however, because of its expense and because it cannot be performed on someone with any metal replacement parts. Patients may need considerable preparation because they must lie still in a long tubelike device that creates a great deal of noise. Preparation for the test may include teaching shallow breathing, anticipatory information about the equipment, a selection of favorite music, and a familiar person to accompany the patient. After the procedure, complications other than a little nausea are rare.

Functional imaging technologies include positron emission tomography (PET) scans and single-photon emission computed tomography (SPECT). These technologies use intravenously administered radioactive isotopes to allow clinicians and researchers to explore physiologic brain functions. The use of radioactive material limits the ability to repeat these technologies with any one individual. The PET scan uses isotopes that emit positively charged electrons (positrons) to measure glucose consumption and cerebral blood flow when an individual is at rest or during the performance of a task that requires thought [2]. PET scans also are being used to study neurotransmitters and their systems. The colorful images created by PET scans indicate areas of the brain with normal or abnormal cellular activity. Abnormal findings have been discovered with several psychiatric and neurologic disorders.

SPECT is a less expensive alternative to PET scanning [2]. The isotopes that are used in this technologic procedure emit only a single photon, are more stable, and are made from molecules that do not occur naturally in humans. Primarily they are used to measure regional blood flow and have been used in clinical and research procedures to differentiate between some psychiatric disorders such as depression and dementia. They also have been used to evaluate changes in blood flow caused by different drugs and may help to identify the density of receptors in various areas of the brain.

Older technologies continue to be used to evaluate the functioning of the brain. These include electroencephalograms, which record the wave patterns of the brain; polysomnography, which is used to evaluate sleep brain wave patterns, and evoked potentials, which record brain waves as they respond to particular stimuli [2]. All of these technologies are noninvasive and inexpensive. They use electrodes applied to the scalp to record the electrical activity of the brain's cortex. Primarily they help to rule out alternative diagnoses to mental illness, such as seizures or tumors.

Genetic explorations

Many indications suggest that several mental illnesses have a genetic cause. Schizophrenia, bipolar disorder, depression, and several other diseases have increased incidence with increased relatedness. It also is becoming clear, however, that most mental illnesses are genetically complex [3] with multiple genes working together to create the heterogeneity of symptoms that are seen clinically. Nevertheless, there is great hope that the Human Genome Project will shed light on the interaction of the multiple genes responsible for the development of symptoms and the response to treatment [4,5].

In schizophrenia, development of the brain from the prenatal period to adolescence is hypothesized to rely to some extent on genetic factors [6,7]. Many activities occur during this period, including brain cell proliferation, cell migration, axonal outgrowth, pruning of neuronal connections, programmed cell death, and myelination. Genes likely coordinate the activation or inactivation of proteins that cause these activities to occur. Disruptions in these activities may be caused by inherited genes, a wild-type allele of a gene that is activated at the time symptoms develop, or a genetic sensitization that leaves individuals sensitive to environmental stressors. It is hoped that whatever is discovered about how genes moderate these complex processes will enhance the ability to treat these debilitating disorders.

Treatment technologies: the search for perfect medications

In the history of psychiatric treatment, most major medication discoveries have been made by accident [8]. Chlorpromazine was discovered as an attempt to create a better drug for use with surgical patients. Its

sedating qualities and behavioral effects encouraged physicians in the mid-1900s to use it with psychotic patients successfully. Imipramine was discovered when attempts to develop new compounds similar to chlorpromazine resulted in a drug more effective in treating depression. At about the same time, a physician in Australia who attempted to sedate manic patients with lithium also found it to be a mood-stabilizing treatment.

From the 1960s to the 1990s, the field remained quiet: Few new compounds were discovered and manufactured. In the 1990s, many developments in psychopharmacology, including the marketing of several new drugs, changed the research and treatment of several mental illnesses, primarily anxiety, depression, and schizophrenia.

Many of the hypotheses about mental illnesses have developed as a result of observations about the mechanisms of action of various drugs. The dopamine hypothesis of schizophrenia developed from several observations: the increased homovanillic acid (the metabolic by-product of dopamine) found in the cerebrospinal fluid after the administration of antipsychotic medications, the similarity of Parkinson's disease (a known dopamine deficiency syndrome) to the extrapyramidal side effect of antipsychotic drugs, the similarity between psychotic behaviors and behaviors after overdose on amphetamines (a known dopamine-releasing drug) that are attenuated by antipsychotic drugs, and the animal studies mentioned earlier.

Today new hypotheses are being developed based on newer drug treatments and understanding of various drugs' mechanisms of action. In depression, the mechanism of action for medications used before 1990 (heterocyclic antidepressants and monoamine oxidase inhibitors) was believed to be their effect on the biogenic amine, norepinephrine. With the success of fluoxetine (Prozac) and subsequent selective serotonin reuptake inhibitors (SSRIs), the hypotheses are shifting to add serotonin as also causative in depression. Similarly, with anxiety disorders, the efficacy of SSRIs and heterocyclic antidepressants as an adjunct to the treatment of agoraphobia with panic attacks and obsessive-compulsive disorder has suggested additional hypotheses about the causes of these disorders. Finally, the enhanced efficacy of clozapine (Clozaril) and other newly developed atypical agents (which have a higher affinity to serotonin) in the treatment of schizophrenia has led to new hypotheses that support the complexity of the mechanisms that cause this disorder as well.

Alternative treatments

From a popular standpoint, alternative and complementary treatments have gained great support for treating many conditions, including mental illness. From a historical perspective, one of the most enduring alternative technologies is biofeedback, a combination of behavioral and alternative methods used for anxiety. Sensors that detect skin temperature, blood

pressure, and pulse are applied to individuals, then they are taught to relax while monitoring their success at decreasing blood pressure and pulse and increasing the temperature of their hands. This gives patients an activity with immediate feedback about their performance that can be applied when they feel anxiety in social situations or at the beginning of a panic attack.

More recently, alternative treatments have included many natural products that are purported to help a variety of mental symptoms, including memory and mood [4]. The preparations that are used in this category are not regulated in the same way pharmaceuticals are. As a result they are inconsistently made, and it is difficult to determine the level of purity and the dose of active ingredient that a person taking these preparations is getting. Few conclusive scientific studies of the efficacy of these products exist; however, research has been funded through the National Institutes of Health. Findings from these studies might help clinicians better understand mental illness and how to counsel patients who have elected to use these products. At the very least, clinicians must remember to assess the use of these products by patients to avoid interactions with conventional psychiatric drugs.

Other alternative methods are decidedly low technology. These methods include yoga, meditation, massage, aromatherapy, guided imagery, and acupuncture. Some methods require training; some require equipment, such as a tape recorder or CD player. As clinicians attempt to help patients with mental illness, research that helps clarify how alternative methods can be used would be welcome.

Relationship between nursing and technology in mental health care

The discoveries that have resulted from the application of technology in psychiatry in the 1990s are enormous. The question is: Has the technology really changed how people who have mental illness are treated? Another question is how nurses can apply or influence these findings. In the remainder of this article, these questions are discussed. Two issues emerge: One is related to the role of nursing as a discipline, and the other is related to the diversity of individual symptoms for even the most well-documented mental illnesses.

Nursing's role is defined as ministering to the patient's responses to illness. In mental health, the effects of a mental illness are life-altering. These effects challenge the patient, the family, and the community to respond and adapt in a functional way. The effects also challenge the care providers and the government to provide the services that are needed by patients with a mental illness to have a functional, satisfying life. As much as clinicians know about the causes of mental illness from the perspective of the brain, they do not have many answers about how to make life better for the patient with mental illness. Mental illness is a social disease for which political

solutions also are required. Nurses can take leadership roles to change policies that affect mental health care, such as the need for parity with other physical/biologic illnesses in insurance coverage and appropriate state funding to cover care for the roughly 5 million Americans with severe and persistent mental illnesses (schizophrenia and bipolar disorder) who would benefit from the newer and more expensive medications.

The greatest implication of the findings of the basic research is the destigmatization of mental illness. Individuals and their families who are affected by mental illness can point to biologic findings to support that these illnesses are caused by a variety of biologic predispositions rather than bad parenting. The message has not been distributed as broadly as it needs to be. Often for some communities and families, this information is small comfort when the results of a fully realized mental illness have caused great loss to a family or community. These losses can vary from the loss of expectations for a child, to the loss of financial and family security during a manic episode, to aggression in the community, to suicide by the patient with mental illness. Nurses, with other mental health professionals, can help decrease the stigma of mental illness by encouraging and participating in community educational offerings and screenings that emphasize the biologic nature of these illnesses.

Clinicians have a greater understanding that distinct cognitive processes and emotional responses are affected to varying degrees in different mental illnesses, and clinicians may plan accordingly. A broader array of medications are available that can be used with equal efficacy, fewer side effects, and adaptability to the unique response of the individual. Behavioral and cognitive rehabilitation techniques exist that are essential to the improved outcome of all mental illnesses, although this sometimes is forgotten in the rush to find the right medication. Many of these techniques are not new, just newly applied based on an increased understanding of brain changes found in mental illness. Nurses can advocate for treatment plans that are multidimensional and multidisciplinary, treatment plans that also include careful titration of the appropriate medications such that side effects are minimized.

The research and application of technologic advances suffer from a significant problem for which nurses can play a major role in the solution. Each major category of mental illness has several symptoms identified by the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition, Text Revision* (DSM IV-TR) [9]. Any given patient can have these symptoms in unique combinations and degrees, however. Often the research that examines the structure of the brain or the biochemical response to medications neglects the discrete symptoms of an individual patient's mental illness because the data have not been collected by clinicians in a standardized way over the course of the illness. The greatest contribution that nurses can make toward improving the applicability of the increasingly complex technology to mental illness is related to this problem. By using

standardized assessment tools to record reliably the manifestations of illness in an individual or a group of patients, researchers will be better able to examine implications and relationships between brain structures and medication treatments [10].

Summary

This is an exciting time to be involved with the care of patients with mental illness. More and more information about what is happening in the brain when mental illness develops is becoming available. Even more important, however, clinicians need not be seduced by the secrets of the brain being discovered. Psychiatric nurses must remember that patients have real and frightening experiences. They alone must learn to adapt and function with their symptoms of mental illness. To the degree that clinicians become enamored of the science and technology, they may lose their empathy with the human experience of mental illness [11]. Nurses, who help people respond to their illnesses, must engage the science with curiosity and engage the person with empathy.

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