BiNE

Biosciences in Nurse Education

Quality Assurance Framework for Biosciences Education in Nursing

Learning Outcomes for Biosciences in Pre-registration Nursing Programmes

Developed by
Steering Committee of Higher Education Academy Biosciences in Nursing Education (BiNE) Specialist Reference Group

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1.0 Background

The Biosciences in Nursing Education (BiNE) Group was set up in 2012 as a Specialist Reference Group of the Higher Education Academy (HEA) Health and Social Care Cluster. The group brings together academics with experience in pre-and post-registration nurse education from across the United Kingdom (UK) to share, discuss and develop bioscience education, scholarship and research. The group is an open group comprised of over 30 experienced nursing and bioscience academics whose work includes teaching biosciences to nursing students at UK higher education institutions (HEIs). The BiNE group defines `biosciences education' as including anatomy, physiology, pathophysiology, biochemistry, genetics, cell biology, pharmacology, and microbiology. These align with the Quality Assurance Agency (QAA) for Higher Education (2001) definitions of natural and life sciences identified in the Benchmark Statement for Nursing. The BiNE group also focuses on promoting teaching, learning, assessment and scholarship for bioscience education to enhance students' understanding and application of biosciences for clinical decision making and nursing care. This Biosciences Quality Assurance Framework (B-QAF) for Pre-registration Nursing Education has been developed through BiNE group activities.

2.0 Introduction

Healthcare in the 21st century is becoming increasingly complex. There is an ageing population at risk of multiple long-term conditions. Technological advances are also leading to the emergence of personalised diagnoses and targeted therapeutics. There is, therefore, an expectation of health professionals, including nurses, to be knowledgeable and competent in the delivery of evidence-informed, holistic and safe patient care. Preparing nurses to meet the challenges of 21st century practice involves developing autonomous practitioners who are able to work effectively with, and lead, multi-professional and multi-agency teams.

The nursing role and nurse education have changed markedly in recent decades. There has been a shift to establish nursing as an academic profession underpinned by a distinct body of knowledge. What was once nurse training has moved from a hospital-based apprenticeship system to the introduction of academic programmes culminating in 2011 with UK-wide degree level programmes delivered collaboratively by approved education institutions (AEI's) and clinical partners (Nursing and Midwifery Council (NMC) 2010). Whilst nursing education has evolved, the nursing role has undergone greater change with nurses expected to be autonomous practitioners, undertaking independent prescribing and delivering nurse-led services to promote health, prevent illness, and care for ill, disabled and dying people in practice/care environments that are dynamic, unpredictable and reactive (International Council of Nursing, 2015). The nursing role has become more demanding and complex. Clarity is therefore required concerning the development of adaptable curricula able to effectively support development of the knowledge base required by practitioners to meet the increasing complexity of the nursing role.

Nursing practice involves the delivery of informational, instrumental and emotional support (Woodward 1997). Nurses must draw upon, and integrate, a range of different types of knowledge and skills in order to provide competent care across the care continuum. Knowledge is drawn from the academic disciplines including humanities, natural and social sciences, and integrated with profession specific knowledge, influenced by political, legal and ethical perspectives. Successful integration of these knowledge domains is crucial to underpin nursing assessment and care, inform clinical decision-making and, when used alongside effective interpersonal skills, contribute to multi-professional team working.

Nursing has evolved, complexity of the role requires an adaptable curricula

All fields of nursing require an in-depth knowledge of anatomy and physiology

Bioscience knowledge is challenging for pre-registration students.

Consistent reports that the learning of bioscience by pregregistration nursing students is problematic.

Nurses in all fields require an in-depth knowledge of anatomy, physiology, and physical and mental health problems across the age spectrum. These are considered an essential basis for safe and effective practice (Nursing and Midwifery Council (NMC), 2010; National Institute for Clinical Excellence (NICE), 2007). Knowledge of the biosciences is important to help nurses understand how determinants of health - social, psychological, behavioural, environmental and genetic factors - impact on health at a physical and physiological level. This includes an understanding of the functioning of the body at different levels (cell, tissue, organ, system) and how the conditions which patients may be at risk of developing, or present with, can arise. This knowledge can help the nurse to understand aspects such as:

- the processes involved in developing health and disease
- the aetiological factors
- risk factors for disease
- how disease may manifest
- the action and side effects of medications
- the action and impact of their nursing care and interventions

Notwithstanding the importance of bioscience knowledge, its understanding, application and integration into nursing practice are recognised as challenging for pre-registration students. Research over several decades consistently reports that the learning of bioscience by pre- registration nursing students is problematic. An emerging body of literature shows that the integration of knowledge which informs practice has also proved to be a difficult transition for many nursing students (Baxter and Boblin 2008). Both nursing students and, indeed, registered nurses experience difficulties understanding and applying bioscience knowledge in practice (Davies et al., 2010; McVicar et al., 2010). Educators and clinical mentors who are developing curricula face difficulties when facilitating the transfer of bioscience knowledge within their programmes. In addition, the literature and results of the National Student Satisfaction (NSS) survey consistently indicate that there is a dearth of physiological content of pre-registration nurse education and programmes. The NMC, who set standards for nursing and midwifery education in the UK, do not specify the extent of biological or scientific knowledge required by nurses at the point of registration. Instead, this is determined by individual AEI's. The absence of explicit national professional guidance has led to variation in the extent and level of bioscience taught across AEI's (Taylor et al, 2015). To address this, students and academics have repeatedly requested that greater emphasis is given to bioscience teaching and its application to nursing practice both in classroom and clinical settings (Taylor et al, 2015; Fell and James, 2012).

This Biosciences Quality Assurance Framework (B-QAF) offers educators a tool to enhance the learning of biosciences in pre-registration nursing curricula through suggested minimum learning outcomes integrated with illustrative examples for curriculum development.

3.0 Aims and Purpose of the Biosciences Quality Assurance Framework (B-QAF) for Pre-registration Nursing Education

Suggested minimum bioscience outcomes for nurses

3.1 Aims
The aims of this B-QAF are to promote:
- curricula that are designed to enhance new registrants' confidence in bioscience knowledge, competence in integrating biosciences in evidence-informed clinical decision making and care, and communication with multi-professional teams and patients
- consistency of bioscience outcomes for pre-registration nursing programmes across the UK

3.2 Purpose
The purpose of this B-QAF is to:
- support AEI's across the UK by suggesting minimum bioscience outcomes for nurses at the point of registration
- enable educators to map biosciences within pre-registration nursing curricula to help them identify and apply relevant concepts to their programmes
- assist educators in developing teaching, learning and assessment strategies for biosciences in pre-registration nursing curricula

4.0 Methodology

The development of this B-QAF for pre-registration nursing curricula was informed by triangulation of the following three methods:

4.1 Survey

Evidence based and peer reviewed

Mirroring issues expressed in the literature and the development of the nursing role, the BiNE Specialist Reference Group (BiNE) identified concerns about the level, content, teaching, assessment and application of bioscience knowledge in nursing programmes. Questions were raised about whether nurses at the point of registration have sufficient bioscience knowledge to deliver safe, evidenced-informed care. These concerns formed an important driver for a UK-wide survey (Taylor et al, 2015). This survey collected the experiences and recommendations of academics from the BiNE membership who deliver bioscience teaching for pre-registration nursing programmes across 10 UK AEI's. A wide variation in the content, level, delivery methods, assessment strategies and time dedicated for bioscience teaching in programmes across the participating AEI's was identified. To address this variation, recommendations were made which included development of a quality assurance framework to incorporate minimum outcomes for biosciences at the point of registration.

4.2 Evidence review
- NMC Standards (2010) and European Directive (2005)
- British Pharmacological Society Guide to Core Curriculum in Pharmacology for Pre-registration Nursing Courses (2004)
- QAA (2001) Benchmark Statement for Nursing
- Genomics Education Programme/Health Education England (2013) How genomics will influence nursing: learning outcomes for education and practice

4.3 Peer-review feedback achieved at fora and symposia from
- academics in bioscience and/or nursing across the United Kingdom
- students
- clinical practitioners

5.0 Structure of Bioscience Quality Assurance Framework (B-QAF) for Pre-registration Nursing Education

This B-QAF aims to assist educators to develop the bioscience focus within pre-registration nursing curricula to enhance knowledge transfer and integration through a developmental process involving:

Developing understanding, application and integration

1. Understanding: developing students' understanding of the underpinning bioscience specific knowledge important for the preparation of nurses at the point of registration
2. Application: helping students to apply bioscience within the AEI and in clinical practice
3. Integration: facilitating students ability to integrate bioscience into their clinical decision-making and nursing practice

The B-QAF is not intended to be a prescriptive tool. Instead, it offers guidance, illustrative examples and support to educators of pre-registration nursing students for consideration when developing bioscience content for inclusion in their respective AEI curriculum.

This document is organised into 4 sections:
- Anatomy, Physiology & Homeostatic Mechanisms
- Pathophysiology
- Pharmacology
- Genetics*

*The Genetics Section has not been developed by the BiNE Specialist Reference Group. Permission has been granted to reproduce the outcomes developed by the HEE/National Genetics and Genomics Education Centre (2013).

For each of the 4 sections, a maximum of 5 high level learning outcomes have been identified. The structure for the B-QAF offers a user-friendly presentation of information for AEI's to help meet NMC (2010) Standard 5 (Structure, design and delivery of programmes) requirements R5.6.1 and R5.6.2 and Domain 3: Nursing practice and decision-making. This structure has been adapted from HEE/National Genetics and Genomics Education Centre (2013).

A resource to guide educators, adaptable and relevant to all fields of practice

Guidelines for use
This B-QAF is intended as a resource for nursing educators to use when developing curricula and in pedagogical planning. It suggests essential learning outcomes, supplementary guidance, and provides a selected number of nursing relevant examples to guide educators to promote engagement and application of the biosciences. It aims to be adaptable for, and relevant to, the domains of nursing and all fields of practice with the objective of facilitating both knowledge gain and knowledge transfer.

Learning outcomes are identified for each of the four sections. For sections 1-3, illustrative examples are also provided for each learning outcome. These are not exhaustive. The illustrative examples provided should be considered as a starting point, not a definitive list nor a prescription for a curriculum. We recognise that there are many other examples that could be developed within the curriculum by individual AEI's giving consideration to academic level and field of practice.

Section four lists the key learning outcomes developed by the HEE/National Genetics and Genomics Education Centre (2013) in relation to genetics education in nursing curricula.

A note on terminology
There are a range of terms used to describe people who are recipients of healthcare across different fields of practice. Patient is a common expression used in the National Health Service (NHS). We recognise that not everyone supports the use of the term 'patient'. However, it is widely understood and can apply to people who are recipients of health and social care in hospitals, in the person's own home, in the primary care setting and in the voluntary, charitable and independent sectors. Throughout this document, for ease of reading and brevity of writing, we use the term `patient' to refer to all groups and individuals who have direct or indirect contact with health and social care providers.

Defining disease
Disease is recognised as any disruption in the homeostatic balance required for optimal cellular function that is expressed at the somatic (whole body) level, affecting physical and mental functioning. In this document, we use the term 'disease' to refer to any abnormal condition that impairs normal functioning.

6.0 Anatomy, Physiology & Homeostatic Mechanisms

Most texts and many programmes organise the subject of anatomy and physiology in terms of 'body systems', together with some discussion of homeostasis. This section of the B-QAF considers the concept of homeostasis in physiology as the most appropriate conceptual principle to introduce to pre-registration nursing students, but does not preclude and encourages the more recent concepts of homeodynamism or allostasis to explain systemic physiology. These concepts possibly offer the nurse educator the greatest scope for effective integration of the biosciences into nursing theory and practice.

The learning outcomes in this section provide a foundation for biological and scientific knowledge with which it is expected all pre-registration nurses should be confident and capable of integrating into their clinical decision-making and practice at the point of registration. It is recognised that nurses' work within diverse contexts and that, during a time of global health transitioning, rapid scientific and technological advances are also occurring. Thus, a commitment to life-long learning in the biological sciences relevant to healthcare is imperative for effective nursing care.

Anatomy, Physiology & Homeostatic Mechanisms

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Learning Outcome 1: Demonstrate knowledge, understanding and application of anatomical and scientific terminology

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Demonstrate familiarity with anatomical and scientific terminology together with the biological concepts relevant to their practice. Use this terminology accurately and appropriately within their practice, to facilitate understanding & communication between professionals and with patients/carers. Evaluate the evidence presented in the biological and scientific literature that is used to inform and direct nursing practice.	Safe practice will require an understanding of anatomy and a variety of scientific and biological concepts dependent upon the scope of practice employed and drawn primarily but not exclusively from the major organ systems listed below: Integumentary/Skin Respiratory Cardiovascular Haematological Lymphatic Immune Digestive Hepatic Renal Endocrine Reproductive Nervous including special senses Muscular Skeletal The application of effective nursing practice will also employ knowledge and understanding of concepts and language common to biological sciences (including microbiology, biochemistry, nutrition, genetics and physics) Nursing is an evidence based profession, the judicious use of the current best evidence frequently requires an understanding of scientific principles and methods		**Example: Interprofessional communication** (i) Describing an infected wound to other nurses and health professionals accurately with correct terminology and reference to surface anatomy (external features of the body) is essential for accurate communication, to prevent delays in wound healing, promote wound healing, avoid complications and improve patient safety and care (ii) Reporting or receiving information about respiratory distress requires precise use of appropriate terminology. For example, wheezing is different to stridor and may require different age-specific responses or healthcare interventions. (iii) Psychological well-being and behaviour emerges from biological function. Accurate assessment, description and recording of a person's psychological state are essential in communication, and decision making between healthcare professionals. Nurses working in all fields engage in physical and psychological health needs and will require detailed knowledge of psychopharmacology, physiological effects and adverse reactions **Example: Communication with patients/carers** Patients are frequently given complex information that is difficult to process. The nurse can help the patient assimilate information at a level appropriate to their needs. (i) A patient offered a radical prostatectomy or a blood test for HbA1c is unlikely to know the meaning or implications of these. Patients will require information to be provided at a level appropriate to their current and on-going needs. (ii) Educating patients and parents/carers about the management of Type I diabetes will include dietary and lifestyle requirements, insulin management practice, avoidance and response to acute and chronic complications. (iii) A diagnosis of Alzheimer's, Parkinson's disease, schizophrenia or bi-polar disorder is potentially stigmatising, requiring skilled interpersonal skills integrated with use of scientific concepts to assist patients and carers to understand and adapt to their condition. **Example: Accurate record keeping** Clear and accurate recording of a patient's health status requires specific reference to anatomical features and commonly includes, but is not limited to body weight, body mass index, fluid intake and output, urinalysis, clinical observations and medication history. These are important to inform healthcare decisions and protect patient safety. **Example: Evidence based practice** The management of venous leg ulcers is complex. Current evidence based guidelines, for example, recommend assessment involving measurement of the ankle brachial pressure index, careful evaluation of wound parameters including precise and accurate recording of the assessment, cleansing with tap water, careful application of compression bandages (Sign 2010).

These outcomes map to NMC Essential Skills Clusters (2010) 1, 6, 8, 14, 17, 23, 25, 27, 28, 29, 31, 32, 35, 36, 38, 39, 40, 41, 42

Learning Outcome 2: Demonstrate knowledge, understanding and application of the physiological principles of health

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Explain the principles and dynamic processes of homeostasis. Apply knowledge of homeostatic processes to nursing practice.	Health behaviour, health outcomes and improvements in health and healthcare delivery require nurses to apply their understanding of physiological regulation and adaptation to fluctuating internal and external conditions, immediately and over the life span. This may include knowledge and understanding of: • Genetic and environmental factors that affect cells, tissues and organs as they develop or adapt, to influence health. • Energy balance & metabolism including thermoregulation. • pH (blood gases, hydrogen ions, bicarbonate ions, buffering, acidosis, alkalosis). • Fluid volumes and hydrostatic pressures (blood, interstitial, lymph, CSF, ICP, intra-ocular, digestive secretions). • Biochemical regulation and function of electrolytes and non-electrolytes, for example sodium, potassium, calcium, urea, nitrogenous waste, an understanding of proteins, enzyme function, lipids, carbohydrates and a variety of vitamins. • Nutrition (maintenance of blood glucose, HDL/LDL and cholesterol). • Excretion & elimination. • Nervous system in sensation & regulation of body systems. • Hormones (negative and positive feedback, feed forward). • Reproduction, development & growth. • Consciousness, sleep, circadian rhythms. • Posture and movement		**Example: Fluid and electrolyte balance** (i) Homeostatic regulation of body fluids is a requirement of life. Children have a smaller fluid volume than adults; disturbance in fluid volume or composition can occur rapidly and pose a significant risk to health. Conversely elderly patients and those dependent upon care can also rapidly become unwell when 'fluid balance' becomes disturbed. (ii) Dehydration can affect mental performance. Altered mental health states, such as depression and in psychosis drinking is sometimes induced increasing risk of hyponatraemia **Example: Energy metabolism** Knowledge and understanding of sources of metabolic energy including glucose, protein metabolism and -oxidation, the formation of keto-acids and its relationship to pH is important in the assessment and care of patients with obesity, diabetes or liver disease. For example, dietary sugar consumption, its metabolic effects and consequences are important factors to consider in life-style/behaviour management; keto-acid production in excess can lead to acute and severe homeostasis disturbance requiring prompt management. **Example: Physical activity** To stay healthy, physical activity is essential. Lack of exercise, injury, acute and chronic disease processes or bed-rest, can lead to muscle atrophy and loss of muscle tone. A complex process of physiological deconditioning leads towards a loss of functional status and the ability to achieve independence in the activities of daily living. Consequences for patients/clients are multiple, including hypotension, altered balance, loss of bone density, increased risk of falls and injury, and reduced continence and mental status. **Example: Nervous and endocrine regulation** (i) Regulation of breathing and cardiovascular function are dependent upon an intact and functional nervous & endocrine system (ii) Hormones regulate a wide variety of physiological processes including metabolism, digestion, fluid and electrolyte balance, circulation, reproduction and growth. Hormones also modulate behaviour such as sleep, mood and arousal (iii) Micturition, defaecation, swallowing and coughing are important reflexes

These outcomes map to NMC Essential Skills Clusters (2010) 1, 8, 9, 17, 21, 23, 25, 27, 28, 31, 32, 36, 38

Learning Outcome 3: Demonstrate knowledge, understanding and application of the physiological basis for clinical observations & tests

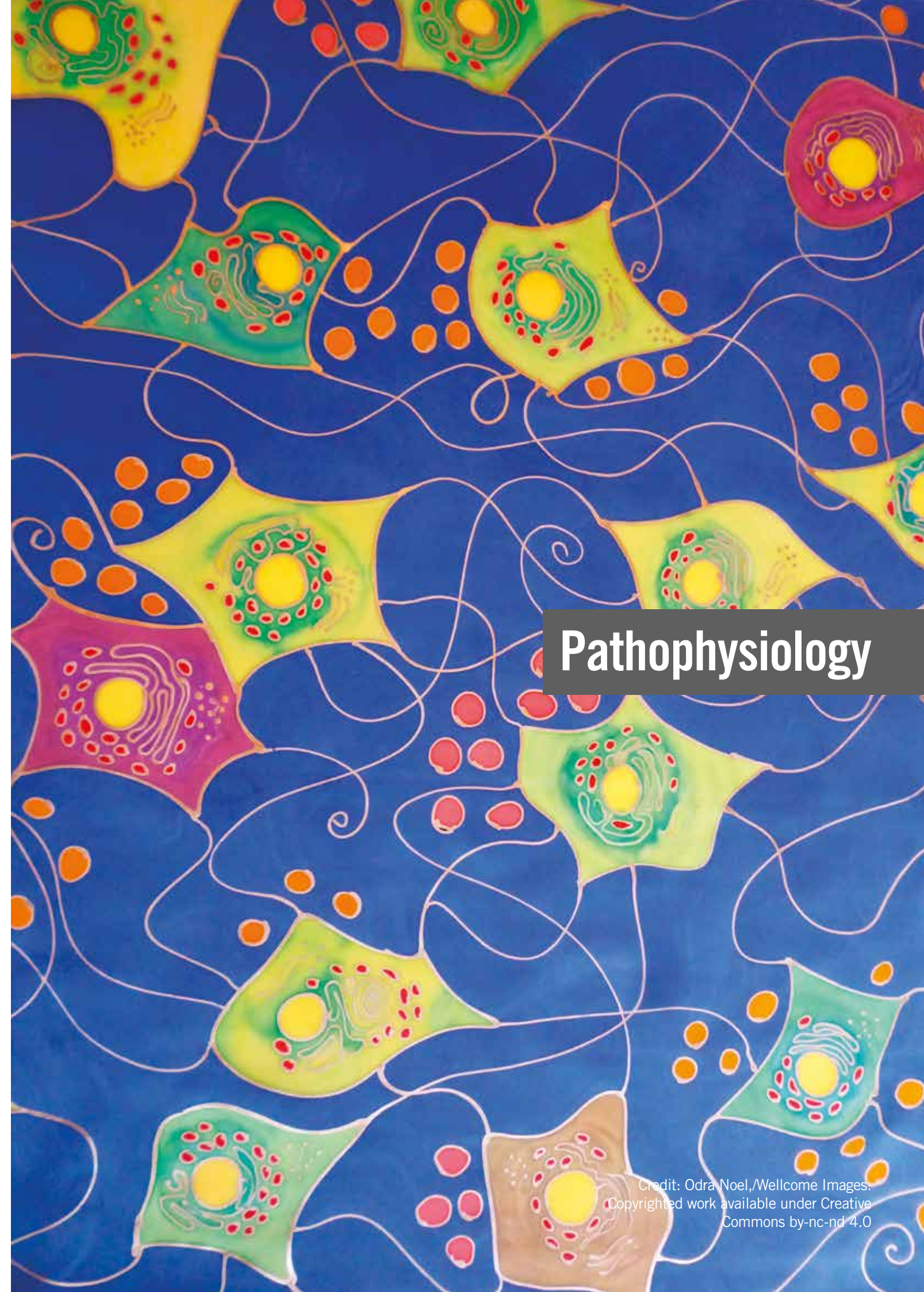| At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Explain the physiological basis of clinical observations and tests. Recognise reference ranges and analyse the physiological significance of observations and tests as they vary between individuals or groups across the life span. Apply understanding of the physiological basis of clinical observations and tests to nursing care to promote patient safety, while maintaining or improving health status.	Nurses should use and reflect upon their knowledge of reference ranges of values to recognise and respond promptly and appropriately to clinical observations and tests. Examples of signs and symptoms of changing health status include, but are not limited, to: • Temperature • Respiratory changes (rate, rhythm, dyspnoea, sounds, effects of posture) • Cardiovascular and fluid changes (BP, HR, bleeding, shock, oedema) • Blood values (haemoglobin, white cell count, platelets, clotting, glucose, gases, blood groups) • Altered consciousness (syncope, sleep, anaesthesia, concussion, Glasgow Coma Scale) • Pain • Skin changes (colour, turgor, rashes, wounds, infection and inflammation) • Urinary changes (colour, turbidity, ketones, smell, nitrites, frequency, urgency, volume, incontinence) • Digestive changes (swallowing, vomiting, stools, constipation, diarrhoea, obstruction, malabsorption, weight (loss and gain) malnutrition) • Changes in functional capacity and behaviour across the lifespan (development, learning disability, fatigue, sensory and motor function, memory loss, frailty, rehabilitation) • Changes in mental health (anxiety, depression, psychosis, dementia, personality) • Reproductive health, fertility and sexual health		Nurses should be aware of, and understand, the normal value ranges, utility and limitations of physiological assessment, clinical observations and tests **Example: Observations** Accurate, timely assessment and recording of a wide variety of observations and measures, with careful and appropriate interpretation, is essential for the planning and implementation of safe, competent care. For example: (i) Monitoring and interpretation of vital signs including temperature, pulse/heart rate, respiratory rate, blood pressure and oxygen saturation (ii) Monitoring and interpretation of blood glucose and urinalysis (iii) Assessing level of consciousness - Altered consciousness may represent a state of tiredness or intoxication or could be indicative of life threatening pathology. (iv) Assessment of skin integrity - changes to skin can indicate a minor and temporary local inflammation, for example sunburn, or a severe acute illness such as anaphylaxis in response to an allergen. (v) Monitoring the appearance of an altered area of skin over a bony prominence that can be indicative of skin irritation or an early sign of the development of a pressure ulcer. (vi) Assessment of GI function - constipation can develop gradually but the effect can be relevant to a variety of health states and physiological processes, including mobility, medication use, nutrition, hydration and psychological state. **Example: Tests** Acutely ill patients, for a variety of reasons, may be at risk of abnormal blood gas concentration or plasma electrolyte concentration and life threatening complications can quickly develop. (i) Knowledge of the effect of oxygen therapy on blood gas regulation can be used to help avoid the development of hypocapnia in patients with COPD. (ii) Knowledge of the influence of electrolyte concentration such as sodium and potassium can be applied to the care of patients at risk of dehydration from any cause, or those treated with diuretic drugs to avoid cardiac complications.

These outcomes map to NMC Essential Skills Clusters (2010) 21, 22, 23, 24, 25, 26, 27, 28, 31, 32, 35, 36, 37, 38, 39, 41, 42

Learning Outcome 4: Apply knowledge & understanding of physiology to health promotion & well-being

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Explain how environmental and occupational factors together with lifestyle choices can impact upon physiological status and public health. Discuss the effects these factors and choices have on the health status of individuals, groups and communities.	Use of physiological knowledge in a collaborative context is vital to promote health regarding (but not limited to): • Dietary choices • Physical activity • Personal hygiene • Substance use • Sleep • Sexual health • Vaccination • Exposure to sunlight & UV • Stress management		**Example: Dietary factors** Nutrition is a key concern for nurses in promoting patient health. This requires application of nutritional and biochemical knowledge, together with knowledge of digestion, absorption and assimilation of nutrients appropriate to individuals. This knowledge has a core place in physiological and nutritional assessment, risk calculation, education and the planning and delivery of holistic care. **Example: Pregnancy & child-bearing** Health inequalities that have their roots in childhood and/or pregnancy (foetal programming) may influence health outcomes. An awareness of the impact of socio-economics and ethnicity on the biological basis for health, against a background of genetic susceptibility and environmental exposure, applied in the context of the lives of individuals and of groups is important. **Example: Immunisation** Immunisation is a crucial disease prevention strategy that saves lives. Uptake of vaccines is influenced by multiple factors, including the safety profile of the vaccine plus the health literacy of and media influence on parents. An understanding of these issues together with an understanding of the biological and scientific basis for vaccine use, such as epidemiology and herd immunity will be essential if nurses are to effectively promote public health and support patients to make informed choices. **Example: Sexual health** Sexuality, influenced by culture, spiritual beliefs or gender identity is pertinent to everyone - young and old people and those with disability. In supporting patients' sexual health, nurses may draw upon knowledge of epidemiology, sexual practices, infection and infection control, microbiology, medications, antibiotic resistance, contraception, alcohol & drug use and understand how each of these factors impact upon reproductive biology and other physiological systems.

These outcomes map to NMC Essential Skills Clusters (2010) 9, 18, 27, 28, 29, 30, 31, 32

7.0 Pathophysiology

Pathophysiology brings together pathology (structural changes within diseased cells, tissues, organs and systems) and physiology seeking to explain the altered physiological processes or mechanisms which lead to the abnormal functioning of organs and result in the development and progression of a disease. Pathophysiology focuses on the abnormal functioning of diseased organs resulting from causes of disease/illness. This can include the acute and long-term progression and functional changes associated with, or resulting from disease and injury. For nurses, knowledge of pathophysiology enables students and practitioners to understand aetiology and clinical manifestations, and this understanding will inform the care for patients.

There are different ways to classify disease. We have chosen a `disease mechanism' approach as this may help students to understand the pathophysiological processes to a range of conditions encountered in clinical practice.

Pathophysiology

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Learning Outcome 5: Demonstrate knowledge and understanding of pathophysiological processes

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Explain the pathological processes (mechanisms) of cell injury and cell death	The following pathophysiological processes underlie most illnesses/conditions/diseases: • Inflammation and wound healing • Infection • Immune response in health and disease: hypersensitivity and immunodeficiency • Genetic (see Section 9) and developmental disorders • Carcinogenesis (the process of cancer formation) • Conditions caused by altered circulation (haemodynamic) • Environmental and occupational health (exposure to harmful environmental agents) • The stress response These represent mechanisms that injure cells, alter their function or lead to cell death which impact on the functioning of tissues, organs and body systems and a disturbance in homeostasis, resulting in the signs, symptoms and clinical manifestations of disease/illness in patients/clients **Understanding these pathological processes will provide the foundations from which students can be helped to apply these to a range of field specific conditions/diseases and illnesses.**		**Example: Cell injury and cell death** Cells and tissues can sustain injury through a number of causes. These include direct damage through trauma, burns, toxic chemicals, radiation and infection. Injury can lead to cell death or loss/alteration of cell function. Cell injury is important for understanding the wound healing process, including stroke and stroke recovery or ischaemia in heart disease, or spinal injury **Example: Inflammation and wound healing** The acute inflammatory response is the body's immediate and protective response to injury and/or infection. It produces a range of symptoms both local and systemic (whole body). Whilst inflammation is protective in the short-term, chronic inflammation is a major contributor to injury underlying most chronic diseases **Example: Infection** Infections are caused by microscopic agents, including viruses, bacteria, ticks and worms to cause cell and tissue injury through a range of mechanisms. The immune response to infection can also cause tissue injury to produce local and systemic symptoms **Example: Immune responses in health and disease** (i) Hypersensitivity, allergy and autoimmunity are damaging forms of the inflammatory response. (ii) Immunodeficiency can be inherited or acquired, for example through infections (HIV) or treatment with immunosuppressive drugs **Example: Genetic and developmental disorders (see Section 9.0)** **Example: Carcinogenesis** Carcinogenesis is a complex process characterised by alteration of genes regulating cell growth and division. Understanding the process of carcinogenesis will help students to understand primary prevention, the development and management of cancer **Example: Conditions caused by altered circulation** Cells require circulating blood to supply oxygen and nutrients and to remove waste products. Normal fluid balance, vascular permeability and blood clotting (haemostasis) are also required. Alterations in any of these can lead to tissue injury and/or major organ failure. Alteration of blood flow, fluid balance, or haemostasis include: oedema, thrombosis, embolism, infarction and shock. Recognition monitoring and intervention by nurses can reduce morbidity. For example, recognition of DVT, administration of vasodilators for angina **Example: Environmental and occupational health** Exposure to harmful environmental agents is an important source of cell and tissue injury. Harmful environmental agents include: tobacco, alcohol, heavy metals, therapeutic drugs, carbon monoxide, ultraviolet light and ionising radiation. These may act as risk or trigger factors and awareness of these environmental factors can inform nurses role in health promotion, primary and secondary prevention **Example: Stress** The stress response is implicated as a risk factor or aggravating factor for some illnesses/conditions, including those affecting mental health. Excess production of the stress hormone cortisol has implications in both physical and mental health including the development of depression and type 2 diabetes. Regulation of the stress response (the HPA axis) can be influenced by childhood factors, and possibly maternal stress levels affecting development in utero. The stress response is also implicated in cardiovascular disease, the onset of autoimmune diseases and hypertension. Understanding the stress response can help nurses to consider stress as a modifier and to inform their delivery of psychological and social care

These outcomes map to NMC Essential Skills Clusters (2010) 21, 22, 25, 27, 29

Learning Outcome 6: Apply knowledge of pathophysiological processes to conditions/diseases/illnesses relevant to field of practice

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Apply their understanding of pathophysiological processes to explain risk factors, pathogenesis, clinical manifestations and management of disease.	Applying a `pathological processes' model of diseases (identified in Learning Outcome 5) has two advantages: • The same mechanism often underlies a range of diseases/conditions. For example, the inflammatory process underlies burns, fractures, infections, cancer, asthma, autoimmunity, allergy. The process of carcinogenesis underlies all cancers • Conditions/diseases with the same underlying `pathological process' may have similar pharmacological interventions. For example, a range of chemotherapies are used for different cancers; anti-inflammatory agents (non-steroidal anti-inflammatory drugs (NSAIDS), steroids) are used in conditions involving inflammation.		**Example: Type 1 diabetes** Type 1 and 2 diabetes are associated with significant morbidity. Risk factors for type 1 diabetes include genetic susceptibility and environmental factors. Autoimmune destruction of the B cells of the Islets of Langerhans results in an absolute deficiency of insulin production that leads to a range of metabolic consequences for the patient. An acute complication of type 1diabetes is ketoacidosis whereas long-term complications include micro- and macro-vascular conditions. Macrovascular conditions are those associated with atherosclerosis. Management is through insulin replacement, diet and lifestyle factors. Nursing has an important role to play in improving outcomes for patients with diabetes. Knowledge of type 1 and type 2 diabetes will enable effective delivery of clinical expertise, health promotion and integration of care with multidisciplinary teams **Example: Cardiovascular disease** Cardiovascular disease is caused by atherosclerosis. Atherosclerosis is a chronic inflammatory disease. Risk factors include smoking which damages the arterial wall, raised levels of cholesterol which promote plaque formation, hypertension, stress, increased age and diabetes. The rupture and subsequent thrombosis of an atherosclerotic plaque in a coronary artery is the leading cause of myocardial infarction. Treatment with statins helps reduce cholesterol levels. An understanding of atherosclerosis will inform nurses awareness of the risk factors, the role of primary prevention strategies, the acute and long term effects of cardiovascular disease, and strategies for rehabilitation and end of life care. **Example: Anaphylaxis** Anaphylaxis is a form of allergy caused by a massive degranulation of mast cells. It is a medical emergency occurring through a type 1 hypersensitivity reaction dependent upon the presence of IgE antibodies. Clinical manifestations include: urticaria, angioedema, bronchospasm, hypotension, loss of consciousness and gastrointestinal symptoms. Other type 1 hypersensitivity disorders include: allergic asthma, allergic rhinitis, allergic conjunctivitis, atopic eczema; some food allergies, and drug allergies. Understanding and recognition of symptoms by nurses can save lives. Allergies are common; nurses have a role in supporting those affected in prevention and management of allergy. **Example: Colorectal cancer** Building on knowledge and understanding of the process of carcinogenesis, students will be aware of the risk factors, different types of cancers and the clinical manifestations of the primary disease and sites of common metastases. A knowledge of national screening programmes, health promotion, early detection, methods of grading and staging and treatment - chemotherapy, hormone therapy, personalised drug therapies, radiotherapy, surgery can inform the application of care, support and management of cancer. **Example: Urinary tract infection (UTI).** Most UTIs are of bacterial origin usually occurring through the `ascending route' from the urethra to the bladder. Gram-negative Escherichia coli are the commonest cause of ascending UTI. There are a number of predisposing factors to UTI: anything that interrupts normal urine flow or complete emptying of the bladder; the shorter urethra in the female; catheterisation. Clinical symptoms are caused by inflammation of the urinary tract and include: dysuria (burning pain of urination), urgency, frequency of micturition. Knowledge of anatomy, physiology, predisposing factors, intervention and management strategies are central to reducing risk and improving the care of patients with UTI.

These outcomes map to NMC Essential Skills Clusters (2010) 1, 9, 21, 22, 25, 27, 28, 29, 31, 32, 36

Learning Outcome 7: Apply and integrate knowledge and understanding of the pathophysiological processes to clinical decision-making

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Integrate their knowledge of pathophysiological processes to their clinical decision making to inform assessment and management of patients/clients across the age spectrum	Applying knowledge of pathophysiological processes will help the nurse to develop their understanding of the aetiology, clinical manifestations, diagnosis and management of a condition/disease/illness which, when integrated into their clinical decision-making, will enable the reduction or limiting of the physical, psychological and social effects for the patient/client, their families/carers and healthcare systems. Teaching and learning strategies are recommended that facilitate application of knowledge of pathophysiological processes and related diseases/conditions/illnesses to inform appropriate assessment of patients/clients risk factors, clinical signs/symptoms and to inform their decision making about a patient's immediate and future/on-going nursing care/management. This will enable students to promote recovery, rehabilitation or meet palliative/end of life care needs as part of the multi-professional/multi-agency team		**Example: Pain** An understanding of pain physiology including the mechanisms by which noxious stimuli are detected, transmitted, interpreted and modulated by the brain can underpin the nursing assessment and management of pain. Applying and integrating pain physiology can inform nurses' understanding of a holistic (or 'total') pain assessment (location, intensity, sensory experience, meaning). The process of pain modulation informs understanding of the pharmacological and non-pharmacological interventions to manage pain. **Example: Cancer screening and prevention** Awareness of the factors, environmental and genetic, which increase the risk of acquiring genetic mutations occurring in the germ-line or in somatic cells will help students' understanding of health promotion advice. This is aimed at reducing a person's risk of developing cancer and also the role of national cancer screening programmes to detect cancer early and targeted at specific populations considered to be at risk. In addition, integrating knowledge of cancer biology can help to understand the role of vaccinations, such as Human Papilloma Virus (HPV), to prevent cancer. **Example: Cancer treatment** Understanding cancer biology and, for example, that some types of breast cancer have increased oestrogen, progesterone or HER2 receptors to which oestrogen, progesterone and growth factors attach promoting the growth and division of cancer cells, can inform nurses understanding of the role of hormone therapies, monoclonal antibodies and other therapeutic modalities. Confidence to support patients in choosing whether to undergo these therapies is dependent upon an understanding of both the disease process and the science underpinning the therapy. **Example: Asthma** Asthma involves a complex interaction between airflow obstruction, bronchial hyper-responsiveness and underlying inflammation resulting in wheezing, cough, breathing difficulties and chest tightness. Asthma may be reversible with appropriate treatment but, if left untreated, can be life-threatening. Awareness of the complex interaction of inherited and environmental factors, together with the inflammatory process, that lead to airway changes and hypersensitivity can help the nurse understand and inform their assessment of a patient/clients risk to asthma and the triggers that may initiate asthma symptoms in those susceptible to airway sensitivity. The nurse can recognise and explain clinical features of asthma, the clinical investigations and management of acute asthma. In addition, the nurse will be able to assess the long term effects of inflammation and educate about living with chronic asthma including educating patients about the action and potential side effect of bronchodilators to promote self-management **Example: Stress response and depression:** Several theories have been proposed relating to the development of depression and a biological basis for this including the stress diathesis model, the monoamine theory and the neurogenesis theory. Individually, and collectively, these theories have provided a biological basis for depression and the symptoms experienced including mood change, cognitive impairment, circadian dysregulation and motor deficits. Knowledge of these theories can help nurses to understand the genetic and environmental factors that may affect a person's response to stress, contribute to dysregulation of the stress response and an individual's vulnerability to depression. The nurse can apply this knowledge to recognise and assess patients who may be experiencing depression incorporating psychological and physical assessment. The nurse can explain the action and role of antidepressants, the role of different psychological interventions and identify potential stressors/precipitating factors to help patients manage an acute episode of depression and promote recovery and rehabilitation.

These outcomes map to NMC Essential Skills Clusters (2010) 9, 10, 21, 22, 23, 25, 27, 28, 29, 31, 32, 35, 36

Learning Outcome 8: Apply and integrate knowledge of pathophysiological processes to promote patients/clients' understanding of their illness/condition/disease

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
As part of the multidisciplinary team, integrate their knowledge and understanding of pathophysiological processes to provide information to patients about their condition/disease in order to promote their understanding, self-care management, minimise risk of harm and facilitate patients engagement in decision-making about their care and treatment.	Teaching and learning strategies involving academics and mentors will enable students to selectively apply their knowledge of pathophysiological processes and related diseases/conditions to undertake assessment of patients' informational needs and for information to be provided at an appropriate level for patients across the age spectrum. Information needs may include promoting patients understanding of any risk factors, health promotion/prevention strategies (including screening), signs and symptoms, disease/illness progression, treatment/management strategies for rehabilitation, recovery and palliative/end of life care		**Example: Asthma** Patients, adults and children, should be involved in the management of their asthma. A Cochrane Review recommended the self-management of asthma and that an individualised written plan increased self-efficacy, knowledge and confidence. The plan should include personalised information about the triggers and symptoms, medication, treatment and emergency actions. Understanding pathophysiological processes, including acute and chronic inflammation, will enable nurses to help patients and their families identify their risk and trigger factors. The nurse will understand how a combination of drugs acts to reduce the symptoms and be able to provide appropriate advice and information about acute and chronic asthma management. Nurses involved in teaching people with asthma how to use inhalers should be familiar with the device and its drug to improve concordance. **Example: Infection** (i) Based on an understanding of infection transmission and antibiotic resistance, nurses have a key role in explaining to patients with bacterial infections how they might limit the spread of infection within their family or community and why they must complete their course of antibiotics as prescribed. (ii) An understanding of viruses and their ability to develop new strains may help nurses to explain to people in vulnerable groups the benefits of an annual flu vaccine. **Example: Depression** Knowledge of how antidepressants work will help nurses explain why they have been prescribed a drug, what potential transitional symptoms to expect when starting or modifying treatment, and the importance of medication concordance. Nurses have a role in enabling patients to choose between treatment strategies where medicines bring physical health risks as well as benefits. Nurses can also explain the role of different psychological interventions and help patients to identify potential stressors/precipitating factors in order to understand an acute episode of depression, promote recovery and rehabilitation.

These outcomes map to NMC Essential Skills Clusters (2010) 1, 2, 6, 8, 9, 14, 21, 22, 23, 25, 27, 28, 29, 31, 32, 35, 36, 40

8.0 Pharmacology

Nurses have professional responsibilities for administration of medicines, monitoring safety and effectiveness of treatments and providing advice and explanations for patients and carers. The NMC (2010) standards for pre-registration nursing education state that people should be able to trust the newly registered nurse graduate to ensure safe and effective practice in medicines optimisation through comprehensive knowledge of medicines, their actions, risks and benefits. The learning outcomes in this section focus on knowledge and understanding of pharmacological principles and terminology required by newly qualified nurses to enable them to achieve these goals. It does not consider aspects of pharmacy practice or medicines management.

The learning outcomes are informed by British Pharmacological Society's Guide to Core Curriculum in Pharmacology for Pre- Registration Nursing Courses (2004) and address NMC standards for Pre-registration Nursing Education (2010), particularly in relation to the Essential Skills Cluster (ESC) section on Medicines Management.

Pharmacology

Learning Outcome 9: Demonstrate knowledge, understanding and application of general pharmacological principles to clinical practice

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Demonstrate familiarity with pharmacological terminology relevant to their practice. Describe the general principles of drug action, pharmacokinetics and pharmacodynamics.	A knowledge of general principles will involve: • awareness and understanding of the types of information available in the BNF, derived formularies and other sources of information relating to safe use of medication. • the principles that affect the absorption, distribution, metabolism and excretion of drugs (pharmacokinetics). • the principles of how medicines exert their effects (pharmacodynamics) and an understanding of dose-response relationships. • recognise how dynamics and kinetics may affect dose requirements and routes of administration.		**Example: Pharmacokinetics** Multiple pharmacokinetic processes influence the effects of drugs. Knowledge of these processes, together with physiological and pathophysiological processes is essential to safe and effective practice. Illustrative examples are: (i) Interactions between food components and some orally administered drugs (e.g. penicillins, tetracyclines) can affect drug absorption. This knowledge is important in explaining why orally administered drugs should be taken as specified regarding ingestion of food. (ii) An understanding of how protein binding affects distribution and the efficacy of a drug will help nurses appreciate the clinical implications of drug administration to patients suffering from conditions associated with hypoproteinaemia e.g. a burns patient may require a lower dose of drug than normal or respond adversely to some drugs. (iii) Knowledge of how drugs are metabolised will enable nurses to recognise potential interactions and help them to understand the implications of the route of drug administration for a clinical response. For example: drugs such as nitrates which undergo high hepatic first pass metabolism are more effective given sublingually than orally. **Example: Pharmacodynamics.** Knowledge of how drugs act on protein targets (e.g. receptors, ion channels, carrier proteins and enzymes) will enable nurses to interpret pharmacological terms and inform them as to anticipated physiological effects, side effects or interactions of a drug. Salbutamol can be used as an illustrative example: (i) Salbutamol is an adrenoreceptor agonist, useful for the management of respiratory disorders such as asthma. Knowledge of autonomic system function and how salbutamol acts on the bronchial tree allows the practitioner to understand drug effects (bronchodilation), potential side effects such as tachycardia and why beta blockers (adrenergic antagonists) should be avoided in patients with asthma.

These outcomes map to NMC Essential Skills Clusters (2010) 36,38,40

Learning Outcome 10: Demonstrate knowledge, understanding and application of basic pharmacology to medicines administered

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Apply knowledge of basic pharmacology, to medicines encountered in own field of practice Demonstrate an ability to communicate effectively with patients, carers and professional colleagues about medications	Nurses will encounter a diverse variety of drugs in practice, core knowledge requirements suggested by the British Pharmacological Society (2004) include the following list of drug groups for pre-registration nursing courses as follows: • Analgesic and anti-inflammatory drugs • Anticonvulsant agents • Antidepressant, anxiolytic and hypnotic drugs • Anti- hypertensive and antithrombotic drugs • Antimicrobial drugs, parasiticides, antiseptics and disinfectants • Anti- ulcer and anti-emetic drugs • Diuretics • Drugs of addiction and misuse • Drugs to treat anaphylaxis and other allergy-based emergencies • General anaesthetics, pre-anaesthetic medication and neuromuscular blocking drugs • Hypoglycaemic agents • Laxatives and antidiarrhoeals • Local anaesthetics Additional drug groups for nursing specialities are also listed. In recognition that pharmacology is an evolving field, nurses will be exposed to newer groups of drugs and therapies not listed and will need to develop their knowledge, for example statins and immunotherapies have recently emerged as important prescribed pharmaceutical agents.		**Example: Clinical management** (i) Nurses require knowledge of basic pharmacology and related physiology to contribute to the different stages of clinical management of medicines (i.e. assessment, planning, implementation and evaluation) and ensure medicines optimisation (NICE (NG5), 2015). (ii) An understanding of the pharmacology of opioids explains why an overdose of parenteral morphine can result in respiratory depression and provides the rationale for monitoring vital signs. (iii) Knowledge of how drugs act enables nurses to understand why a child with asthma may be prescribed a combination of drugs, such as salbutamol, dexamethasone and montelukast, which all act in different ways to reduce the symptoms of asthma. Nurses should also be able to apply this knowledge to explain and monitor for the efficacy and potential occurrence of potential adverse effects. For example, be aware that ingestion of non- steroidal anti-inflammatory drugs (NSAIDs) can exacerbate symptoms of asthma in some individuals. **Example: Patient counselling and education** Nurses have a key role in ensuring best outcomes from medicines use through individual patient counselling and education. They must be enabled to actively practice medicines optimisation. (i) Knowledge of how antidepressants work to alleviate depression will help a nurse explain to a patient why they have been prescribed a drug, what potential transitional symptoms to expect when starting or modifying treatment, and the importance of adherence. Nurses have a role in enabling patients to choose between treatment strategies where medicines bring physical health risks as well as benefits. (ii) Based on an understanding of antibiotic resistance, nurses have a key role in explaining to patients why they must complete their course of antibiotics as prescribed.

These outcomes map to NMC Essential Skills Clusters (2010) 33,36,38,40

Learning Outcome 11: Apply knowledge and understanding of mechanisms of drug interactions and adverse drug reactions to medicines optimisation

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Outline the different mechanisms of drug interactions. Identify how drugs may produce adverse effects. Recognise responses to administered medications including therapeutic and adverse effects.	It is important that nurses are able to recognise common or significant signs associated with adverse drug reactions (ADRs) and respond appropriately. Nurses are required to report adverse incidents and near misses This requires a sound knowledge of predictable side effects of any given drug in addition to having an awareness of possible interactions. It is also important for nurses to demonstrate an awareness of the potential for interactions with 'over the counter' (OTC) and internet purchased medicines and herbal remedies.		**Example: Vigilance** Drug – drug interactions are numerous, as evidenced in appendix one in BNF. A nurse must be vigilant when a patient is prescribed a new combination of drugs for potential interactions / adverse reactions. Examples may include: (i) Pharmacokinetic interactions: A patient on warfarin may suffer from excessive bleeding if administered drugs that are highly protein bound e.g. aspirin (due to displacement) or drugs that inhibit the enzymes that metabolise warfarin e.g. cimetidine. (ii) Pharmacodynamic interactions: Benzodiazepines and alcohol produce additive effects which can cause severe central nervous system depression. **Example: Patient education** (i) A patient needs to be advised to take tetracycline capsules on an empty stomach as the binding of this drug to dietary calcium in the stomach from a previous meal can slow its absorption from the GI tract. (ii) A patient should be informed of potential interactions with herbal products and OTC medications. St John's wort, for example, interacts with a large number of medications such as antidepressants, oral contraceptives, warfarin and digoxin and can decrease or increase the effect of some medication or possibly induce adverse effects

These outcomes map to NMC Essential Skills Clusters (2010) 36,38,40

Learning Outcome 12: Demonstrate an understanding of how individual variation can affect patients' responses to medicines

At the point of registration, nurses should be able to:	Supplementary guidance		Illustrative examples
Describe factors which can modify patients' responses to medicines. Analyse the effects of patient specific factors / physiological state on drug responses and apply that knowledge to individualised drug therapy. Explain what is meant by pharmacogenetics / pharmacogenomics and its clinical importance to medicines management.	Cross referenced to NGEDC guide: "How genomics will influence nursing: learning outcomes for education and practice" in relation to pharmacogenomics.		**Example: Vigilance** The safe administration of drugs requires nurses to understand ways in which the drug action is altered by factors which affect the kinetics and dynamics of a drug including diet, disease, pregnancy, age, body composition, gender and genetic variation. If drugs have a narrow therapeutic window (e.g. digoxin or lithium), plasma level of the drug could become toxic, resulting in an adverse reaction. **Example: Physiological status** Nurses should be aware that liver failure, renal failure or pregnancy, and diseases such as congestive heart failure can significantly reduce drug clearance thus prolonging the half-life of the drug. **Example: Genetic variation** (i) Nurses should appreciate the utility of genomic information in explaining patients' response to a drug, including predicting the efficacy of a particular drug effect and adverse reactions (NGEDC, 2013). Afro-Caribbean patients, for example, respond less well to ACE inhibitors. Genetic testing is undertaken to predict adverse reactions: genetic testing of HIV/AIDS patients for gene variant HLA-B*5701 will determine whether a patient is prescribed abacavir, because patients with this polymorphism display a fatal hypersensitivity to the drug. (ii) Genetic testing is undertaken to determine treatment include gene expression profiling and tests which inform decisions for adjuvant chemotherapy in cancer. Examples include HER2 expression in breast cancer.

These outcomes map to NMC Essential Skills Clusters (2010) 36,38,40

9.0 Genetics

The Genetics Section reproduces the learning outcomes from HEE/National Genetics and Genomics Education Centre (2013) How genomics will influence nursing: learning outcomes for education and practice.

The key learning outcomes are listed below.

1. Understand the different ways in which genomic information can influence patient care
Nurses should:
Appreciate the utility of genomic information in:
- Refining a diagnosis
- Identifying the cause of a genetic disease
- Targeting treatment
- Explaining a patient's response to a drug, including predicting the efficacy of a particular drug effect and adverse reactions
- Diagnosing and treating infections

2. Describe the structure and function of DNA, how it is organised to form the genome and how it is inherited
Nurses should:
- Understand that the genome comprises all of the DNA within a cell
- Understand the structure of the cell, the cell cycle and cell division and where the genetic material is located
- Understand that chromosomes are composed of DNA where genes are arranged in a linear order and that the sequence of bases within the DNA contains instructions for the cell
- Understand that the DNA sequence contains a large number of regulatory elements as well as genes used to make proteins
- Understand the role of meiosis in:
  - Producing gametes
  - Creating genetic variation
- Understand that fertilisation is the fusion of the male and female gametes
- Understand the role of mitosis in:
  - Tissue growth and repair
  - Creating genetically identical cells

3. Explain how alterations to the genome can influence health and disease
Nurses should:
- Understand that genetic variation contributes to features such as height and blood pressure and ABO blood groups
- Understand that many medical conditions are caused by the interplay of multiple genetic and environmental factors (multi-factorial conditions) such as learning disabilities
- Understand the implications of alterations to the genome including:
  - Changes in chromosome number and structure
  - Changes in DNA sequence and copy number variation
  - How changes affect genes and protein function
  - How changes affect health and treatment decisions
  - Normal variants (polymorphisms)
- Understand that genetic conditions may be classified as:
  - Multifactorial condition
  - Single-gene conditions
  - Chromosomal conditions
  - Mitochondrial conditions
- Understand that accumulation of genetic alterations in somatic cells may lead to cancer

4 Understand the importance of family history information
Nurses should:
- Be able to ask appropriate questions in order to collect family history information
- Understand how to ask questions in a logical, sensitive manner, appreciating that this could have implications for other members of the family
- Understand approaches to recording family history information, including the family tree (pedigree)
- Be aware of pedigree symbols and patterns of inheritance seen in a family tree
- Be able to draw a family tree up to three generations, including health information
- Appreciate that sharing a patient's health information with the patient's consent can be beneficial for other family members
- Be able to consider the psychological impact of diagnosis including stigma, uncertainty and guilt
- Be aware of the ethical and legal issues surrounding gene/genomic testing

5. Understand the clinical indicators within an individual or family that may suggest a major genetic cause and act on these accordingly
Nurses should:
- Be aware of important clinical clues that may indicate a genetic condition, such as age of onset/diagnosis
- Be aware that some conditions will be new to an individual within a family (de novo)
- Be aware of the role of the clinical genetics service in supporting individuals with or at risk of genetic conditions
- Be aware of the societal concerns surrounding the use of the genetic and genomic information
- Be aware of relevant patient groups that provide information and support
- Know where to find resources for further information on genetic and genomic conditions.

10.0 References

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Notes