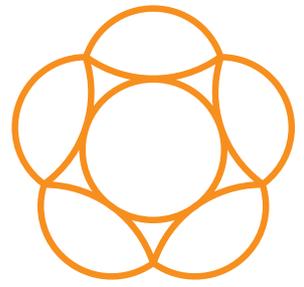




igniting our potential



Centre of the Cell

Disease Detection and Diagnosis Workshop

Introduction

These activities teach pupils to think about how doctors and other staff diagnose illnesses and how new diagnostic tests are developed. Pupils also consider when screening programmes for diseases are appropriate.

How do doctors diagnose disease? First, they take note of a patient's symptoms. Symptoms are physical signs produced by a disease, but they are not the cause of that disease. If you have a fever, this is your body's response to an infection. The infection causes your immune system to respond by raising the body's temperature, and the fever is the symptom of the infection.

Curriculum Links

KS3 Science
KS3 History
KS3 Citizenship

SQA National Guidelines (5-14)
Environmental Studies

Keywords

Symptoms
diagnosis
diagnostic tests
how research has improved

diagnostic tests
screening programmes
making decisions about public health

Contents

Activities	Materials
Activity 1 Diagnosis activity	Diagnosis Activity Cards (for teachers) Diagnosis Activity Cards (for pupils) Diagnosis Cards
Activity 2 How Clinical Research Can Lead to Improvements in Diagnostic Tests	List of Diseases List of Diagnostic Tests Explanation of Diagnostic Tests
Activity 3 Deciding when to use Screening Programmes	Screening Programme Cards Advice Cards



Activities

Activity 1: Diagnosis Activity

Background Information

When diagnosing a patient, doctors need to consider factors such as the patient's lifestyle, location, medical history, and family medical history, as well as a patient's symptoms. This is because:

- Several diseases have the same symptoms, but different causes. Therefore, they need different treatments
- New diseases may appear that have similar symptoms to known diseases
- Doctors use their knowledge of medicine to determine what diseases are most likely to be found in a particular patient

Teacher-led Activity (whole class)

Materials

Diagnosis Cards (page 7-8)

Diagnosis Activity Cards (for Teachers) (page 6)

- Split the class into four groups, and give each group a set of four Diagnosis cards. Each card describes one of four diseases that could cause watery diarrhoea as a symptom.
- Assign each group hypothetical patient: A, B, C or D. At this point, the pupils have no other information about their patient.
- Explain to the class that each group will be playing the role of a GP, trying to diagnose a patient. All four groups have a patient who has come to their GP surgery with the symptom of watery diarrhoea. But each patient has a different cause of their problem.
- Each group will examine the disease descriptions on the Diagnosis Card and come up with a set of five questions to ask the patient. As the teacher, you will have Patient Cards with full descriptions of each patient, and can provide assistance.
- Each group will ask the teacher their questions. As the teacher, you can only give answers to the five questions the pupils ask, so pupils need to be sure that they are asking questions that allow them to give a likely diagnosis.
- Finally, after receiving the answers to their questions, each group will deliberate and give their diagnosis and reasons for their diagnosis to the class.
- The teacher will then reveal the most likely diagnosis for each patient, based on the present evidence and discuss this with the class.

Follow-up questions

- If you were the GP, how would you be sure that your diagnosis was correct?
Consult specialist doctors with expert knowledge of likely diseases, determine which diagnosis is most likely in the patient's circumstances.
- What else would you do before prescribing treatment?
Confirm diagnosis with diagnostic tests.



Activity 2: How Clinical Research Can Lead to Improvements in Diagnostic Tests

Background Information

In the present day, doctors first analyse a patient's symptoms to determine what condition they are most likely to have. Doctors will then try to confirm this diagnosis with diagnostic tests.

Through the ages, different tests have been used to diagnose diseases. Have diagnostic tests improved?

Teacher-led Activity

This activity can be done in groups of any size from one pupil to the whole class.

Materials

List of Diseases (page 9)

List of Diagnostic Tests (page 10)

Explanation of Diagnostic Tests (page 11)

- Give the pupils the lists of Diseases and Diagnostic Tests.
- The pupils need to match each Diagnostic Test to one Disease.
- When the pupils have made their decisions, use the Explanation of Diagnostic Tests to discuss the correct answers and how the tests are carried out.

N.B.: Diabetes is no longer diagnosed by tasting urine; this is an ancient diagnostic test which has been replaced by modern methods.

- Ask the pupils which of these tests they think are the most:
 - Accurate
 - Comfortable
 - Safe

Follow-up Questions

- There are several tests for the same diseases. Are some tests better than others? How?
- Why are scientists doing research to improve diagnostic tests?
To make diagnosis faster, more accurate, less expensive, or safer to the patient.
- How do scientists test diagnostic tests?
They use clinical trials where the diagnostic tests are tested in healthy individuals to determine whether the tests have dangerous side effects and are safe to use. Then they test the new tests on patients, comparing them to the current tests to determine how accurate, rapid, and safe the new tests are.
- Can diagnostic tests be used if no symptoms are observable? When would such tests be advisable?
If a disease has no observable symptoms, it is said to be asymptomatic. Several diseases, such as HIV or Tuberculosis, can appear to have no symptoms for a long time, even though the disease is present in the body and can be determined with a diagnostic test. Tests that show the presence of antibodies (proteins produced by the immune system in response to pathogens) can be very useful when a disease is present, but asymptomatic. Scientists do research on patients with these diseases to find early markers that show the disease is present before symptoms appear. They can use these markers to develop new tests. This is important, because sometimes people who are asymptomatic can still spread an infection to others. Early diagnostic tests can help prevent this.



Activity 3: Deciding when to use Screening Programmes

Background Information

A screening programme is a scheme where diagnostic tests are offered to appropriate groups of people who are at risk of disease. Screening programmes are often funded by governments to promote public health.

In 1968, Wilson and Jungner of the World Health Organisation developed ten principles which should govern a national screening programme. These are:

1. The condition is an important health problem
2. Its natural history is well understood
3. It is recognisable at an early stage
4. Treatment is better at an early stage
5. A suitable test exists
6. An acceptable test exists
7. Adequate facilities exist to cope with abnormalities detected
8. Screening is done at repeated intervals when the onset is insidious
9. The chance of harm is less than the chance of benefit
10. The cost is balanced against benefit

They are the points which need to be considered when deciding whether to start a screening programme. In England and Wales, NICE, or the National Institute for Health and Clinical Excellence, considers all the available evidence before setting guidelines for the NHS to make decisions about which tests to offer, and when. NICE is an independent body that researches and provides guidance on research. Individual NHS trusts are able to make further decisions about what testing services they will and will not offer.

Doctors and medical professionals need to use careful judgment when they give patients diagnostic tests. Several of these tests can be expensive, painful, and, in some cases, unnecessary.

If diagnostic tests are available on the NHS, there may also be limits on the number of testing facilities available, so doctors need to make sure that people who have the greatest need have an opportunity to take the tests.

Relevant Links

A guide to NICE:

<http://www.nice.org.uk/nicemedia/pdf/NewguidetoNICEApril2005.pdf>



Teacher-Led activity (whole class)

Materials Needed

Screening Programme Cards (pages 12 - 14)

Advice Cards (page 15)

Screening Programme Demonstration

- Divide the class into groups of 4 – 5, and give each group a Screening Programme card to discuss. Each card will describe a situation, giving details of a medical condition and a possible diagnostic test or screening programme. Each group will act as a NICE review board—it is their job to consider the pros and cons of a test or screening programme, and decide whether they would recommend it to NHS trusts.
- Each group must decide on the best course of action to take, considering the factors below:
 - Who should be offered this test?
 - What are the risks of the patient knowing/not knowing the test results?
 - Accuracy of the test
 - Likelihood that the patient needs to be tested
 - Safety of the test
 - Availability of the test
- After considering the evidence and debating, groups of students will discuss their decision in front of the class.
- Be sure to explain that diagnostic tests can be inaccurate by giving false positive results (someone without a disease tests positive for it) or false negative results (someone with a disease tests negative for it). Ask the class what the consequences of either type of inaccuracy could be.
- The class will then have a chance to see what the current NICE guidelines are (see the Advice Cards in the Materials section of this document) and can discuss the reasoning behind any similarities and differences between the NICE guidelines and their own policies.

Follow-up Questions

- How does clinical research affect the way diagnostic tests and screening are used?
Improvements to diagnostic tests may mean that tests are safer, more accurate, or more comfortable for patients, which could mean that more people are likely to come forward for testing. Clinical research can also lead to ways to make diagnostic testing less expensive, which means that testing may become more available.
- How can research-led improvements in diagnostic testing lead to improvements in public health?
Research can also lead to tests that diagnose people who are asymptomatic; targeted screening programmes could then prevent further infection.
- Were there any current NICE or NHS guidelines for screening programmes that you disagreed with? Why?

Materials

Activity 1: Diagnosis Activity Cards (for teachers)

Patient:	A
Age:	19
Sex	F
Location:	Australian backpacker in Laos
Medical History:	Broke left arm, aged 5
Family Medical History:	One grandparent has diabetes, father's side
Other symptoms:	Dehydration
Recent events:	Went swimming in a stagnant pond
Diagnosis:	CHOLERA

Patient:	B
Age:	37
Sex	F
Location:	Scotland
Medical History:	Treated for postnatal depression last year with antidepressants
Family Medical History:	Grandparents on mother's side died of heart disease
Other symptoms:	Dehydration
Recent events:	Ate some unwashed salad at a farmer's market
Diagnosis:	E.COLI POISONING

Patient:	C
Age:	4
Sex	M
Location:	California
Medical History	premature at birth, slow growth and short stature
Family Medical History	Two cousins are unable to digest gluten
Other symptoms	Abdominal pain
Recent events:	Ate three bowls of cereal
Diagnosis:	COELIAC DISEASE

Patient:	D
Age:	68
Sex	M
Location:	London
Medical History:	smoker, alcoholic with liver disease, diabetic
Family Medical History	grandfather died of pancreatic cancer, family history of alcoholism
Other symptoms:	Abdominal pain, jaundice
Recent events:	nothing has changed except for this new attack of diarrhoea
Diagnosis:	PANCREATIC CANCER (ENDOCRINE TUMOUR)

Cholera

DESCRIPTION:

Cholera is an infectious disease caused by bacteria that colonise the small intestine and affect the body's absorption of water. Cholera causes violent diarrhoea and extreme losses of bodily fluid. This can lead to dehydration and death.

WHO IT AFFECTS MOST:

It can affect anyone who drinks contaminated water or ingests food contaminated with bodily fluids of someone with the disease. People with compromised immune systems are more susceptible.

WHERE MOST VICTIMS LIVE:

The bacteria which cause this disease are found in brackish waters. It is not often found in areas with chlorine-treated water supplies.

CAN YOU INHERIT IT FROM YOUR PARENTS?

No.

Other symptoms?

Diarrhoea progressing to severe dehydration.

HOW IS IT TRANSMITTED?

Ingestion of contaminated water or bodily fluids from another infected person.

E. Coli Infection

DESCRIPTION:

E.Coli are bacteria that live in the lower intestine. There are several strains of E.Coli that are harmless, but some can cause diarrhoea, blood and fluid loss, and dehydration. If untreated, an E.Coli infection can sometimes progress to kidney failure.

WHO IT AFFECTS MOST:

Anyone who eats food that has been unhygienically prepared.

WHERE MOST VICTIMS LIVE:

E.Coli can affect people all over the world, but is most prevalent in places where there is poor sanitation.

CAN YOU INHERIT IT FROM YOUR PARENTS?

No.

Other symptoms?

Diarrhoea and (depending on type of E.Coli): urinary tract infections, sudden kidney failure, possible progression to dehydration.

How is it transmitted?

Ingestion of food contaminated with faeces.



Coeliac Disease

DESCRIPTION:

Coeliac disease is an autoimmune disease, where the body's immune system attacks its own tissues. This immune reaction is triggered when a person with coeliac disease eats foods containing gluten, a protein found in wheat, rye, barley and some other grains. Coeliac disease can cause diarrhoea, fatigue, failure to thrive and grow (in children) weight loss, mouth ulcers, and numerous other symptoms.

WHO IT AFFECTS MOST:

This disease can affect anyone, and can be diagnosed at any time in life

WHERE MOST VICTIMS LIVE:

This disease can affect people anywhere.

CAN YOU INHERIT IT FROM YOUR PARENTS?

Yes. There is an increased risk of 1 in 10 if a member of your family has coeliac disease. However, some people with coeliac disease have no history of the disease in their families.

Other symptoms?

Abdominal pain, excessive farting, failure to grow properly (in children), joint pain

HOW IS IT TRANSMITTED?

This disease is caused by genetic mutations, and is not contagious.



Pancreatic Cancer (Endocrine tumour)

DESCRIPTION:

Pancreatic cancer is the result of the uncontrolled replication of cells with damaged DNA, which grow to form tumours. The pancreas is an organ that produces hormones that are important to digestion, and pancreatic cancer (especially endocrine tumours) can disrupt the pancreas' ability to regulate these hormones.

WHO IT AFFECTS MOST:

This disease is most common in men aged 60-70. Heavy drinking and smoking can also be contributing factors. This disease is more often found in people who already have diabetes.

WHERE MOST VICTIMS LIVE:

This disease can affect people anywhere

CAN YOU INHERIT IT FROM YOUR PARENTS?

Sometimes: 1 in 10 cases are caused by an inherited faulty gene.

Other symptoms?

Back pain, abdominal pain, weight loss, jaundice, diabetes.

How is it transmitted?

This disease is not contagious; it is caused by a combination of genetic and lifestyle factors.

Activity 2: How Clinical Research Can Lead to Improvements in Diagnostic Tests

List of Diseases:

Diabetes:

Diabetes is a condition where the body is unable to break down glucose from sugary or starchy food so it can be used for energy. This leads to high levels of sugars in the blood, and can lead to weight loss, extreme thirst, nerve damage, coma and death if left untreated.

Breast cancer:

Breast cancer is the most common form of cancer in the UK. It affects one in nine UK women at some point in her lifetime. Cells in the breast tissue which have DNA damage and grow abnormally can become tumours.

Colon cancer:

Colon cancer is the third most common form of cancer in the UK, after breast and lung cancer. DNA-damaged cells inside the large intestine (colon) grow abnormally and form tumours. Colon cancer can be difficult to diagnose because it is internal, and can present many symptoms common to other digestive diseases.

Activity 2: How Clinical Research Can Lead to Improvements in Diagnostic Tests

List of Diagnostic Tests:

- Taste urine for sweetness
- Mammogram - X-ray soft tissue in the body
- Biopsy - remove and study a lump from the body
- Blood sugar test - measure sugar levels in the blood
- Ultrasound - take an image of a body part using sound
- CT scan - make a 3D X-ray image
- Colonoscopy - insert a small camera into the body
- Barium enema/X-ray - line part of the inside of the body with barium before an X-ray to help show the soft tissue

Activity 2: How Clinical Research Can Lead to Improvements in Diagnostic Tests

Explanation of Diagnostic Tests

Tests for Diabetes:

Taste urine for sweetness:

If urine tastes sweet, this could mean that sugar (glucose) from food is not being used by the body for energy and is passing into the body's waste. The ancient Greeks, Egyptians, and Indian Ayurvedic physicians used to diagnose diabetes by tasting urine.

Blood sugar test – Measure sugar levels in the blood:

The glucose levels in blood can easily be monitored with a blood sample (from a pinprick) and a chemical indicator. Diabetics use this and strips that test the sugar content of their urine to measure and control their blood sugar levels.

Tests for Breast Cancer:

Mammogram – X-ray soft tissue in the body:

Radiologists take X-ray photographs of the breast, and examine them for shadows which might be the signs of tumours. The use of X-ray radiation poses a cumulative cancer risk (the greater one's lifetime exposure to radiation, the greater their cancer risk) and is not recommended for younger women (under 40) or people who have already been exposed to excess radiation.

Ultrasound – Take an image of a body part using sound:

Ultrasound scans of the breast bounce sound waves off the breast tissue to take images of the tissue. An ultrasound can determine if a breast lump is fluid-filled (and benign), but it cannot confirm whether a mass is cancerous.

Biopsy – Remove and study a lump from the body:

If a lump is found in the breast, a biopsy (tissue sample) is taken and analysed. This can confirm whether the cells in a lump are cancerous or not, and determine further treatment.

Tests for Colon Cancer:

Barium enema and X-ray – Line the inside of the body with barium before an X-ray to help show the soft tissue:

In this procedure, patients have a chalky solution of barium inserted into their rectum. The barium shows up in X-ray photography. It coats the interior of a patient's colon so that the insides can be photographed. There is a slight risk of bowel perforation and infection with this procedure.

Colonoscopy – Insert a small camera into the body :

In this procedure, a fibre-optic tube is inserted into the anus to take pictures of the inside of the colon. It can be uncomfortable, and there is a slight risk of perforating the bowel and causing infection. Colonoscopy can also take biopsies of affected tissue, and is the preferred diagnostic method.

CT scan – Make a 3D X-ray image:

CT, or Computerised Tomography, is a scanning technique that uses rotating X-rays from multiple sources to get a 3D image of internal organs. The patient lies inside a tube so that X-rays can be taken from every angle. This technique may give a more accurate image than a standard X-ray, but it is not yet commonly used to diagnose colon cancer.

Activity 3: Deciding when to use Screening Programmes

Screening Programme Cards:

Prostate cancer screening programmes

The prostate is an internal male sex gland that is located around the urethra, between the bladder and the anus. It increases in size as men age. Because of its location, it is difficult for men to perform self-examinations to find any lumps or changes. A quarter of all cancers in men in the UK are prostate cancer. Most of these affect men over 60.

A screening programme would test men for prostate cancer by testing their blood levels of PSA (prostate specific antigen). Two thirds of men with high levels of this chemical in their blood will have prostate cancer. Doctors would follow a positive test with a rectal examination, and by putting a small tube inside the anus to take a sample of the prostate.

Pros:

- Screening can diagnose prostate cancer before it becomes life-threatening.
- Prostate awareness could increase – prostate cancer is a disease that is often diagnosed later because traditional methods of checking for it (rectal examination) may be embarrassing, and men avoid having this checked.

Cons:

- Prostate cancer is a cancer that develops slowly, late in life, and an older man who is diagnosed with prostate cancer may wish to not proceed with chemotherapy, with its unpleasant side effects (hair loss, nausea, weight loss, fatigue) for these reasons. Most older men who have prostate cancer die *with* it, but not *of* it.
- All screening programmes can produce some harm, including discomfort and anxiety.

DIY liver function kits

The liver is an organ that has more than 500 functions, including filtering the blood, aiding digestion, and manufacturing enzymes and hormones. The liver can be damaged by liver disease, infection, or the use of drugs and alcohol. The liver is a hardy organ that can repair itself and function even when damaged, and often liver damage is asymptomatic and difficult to detect.

In a DIY liver function test, people take a small sample of blood and send it to a laboratory where the sample is analysed. Scientists look for levels of certain chemicals, called biomarkers, which indicate the presence of liver disease.

Pros:

- A simple, at-home test can detect biomarkers of liver damage. Users send a blood sample by post to a laboratory, and are sent their results.
- A “damaged” result might convince patients to stop using alcohol or drugs, and visit a doctor.

Cons:

- The liver is a complex organ that metabolises hundreds of different compounds. How would users of this test be able to interpret the results?
- A GP would be able to give advice to a patient who tested positive for liver damage, or recommend further tests or treatment. A person using a DIY liver function kit would not receive this care immediately.
- If an alcoholic took this test and found no result showing liver damage, would he or she continue drinking heavily

Home HIV tests

HIV is a virus that causes the breakdown of the body's immune system. It can be transmitted through the exchange of bodily fluids, either sexually, from an infected mother to her baby through the mother's breast milk, or between intravenous (injecting) drug users who share hypodermic needles with an infected person. People who have HIV may be asymptomatic for years, and not know that they have the virus. During this time, they can still pass HIV on to others.

In a home HIV test, people take a small blood sample themselves, and the test to see if the virus is present gives them their results in minutes.

Pros:

- These kits let people know, in one minute, whether they have HIV.
- The anxiety caused by waiting for results in NHS testing centres (this often takes two weeks) may prevent some people from getting tested.
- These tests can be performed at home, in private settings.

Cons:

- An HIV diagnosis is very serious and has great impact on a patient's life. Should they learn this news on their own, or in the company of a medical professional who can provide advice?
- How reliable are the tests? What could happen if a user has a false positive or false negative result?
- How well do the users understand how to use the tests?
- If tests are performed at home, anonymously, it is more difficult for the NHS to know the number of HIV-positive people in the UK, and to provide adequate prevention and treatment campaigns.

Breast cancer screening by mammography in younger women (under age 50)

Breast cancer occurs when cells in the breast with damaged DNA grow uncontrollably, forming tumours.

Mammograms can detect tumours that are too small to be detected by touch. In a mammogram, plates on a special machine flatten a woman's breast so that the machine can X-ray the breast to search for lumps in the breast tissue.

Pros:

- While 80% of breast cancer cases in the UK occur in women who are over 50, it is the most frequently occurring cancer in younger women.
- Breast cancer is more easily treated the earlier it is detected.

Cons:

- The breast tissue in younger women is denser so it is more difficult to get an accurate image. This may cause more false positive scan results and spread fear.
- Exposure to radiation from mammography over several years could pose a slight increased risk of cancer.
- Breast cancer screening costs money; is an expanded screening programme cost effective?

Compulsory pregnancy tests in all women before surgery/prescribing medication

Pregnancy can be detected in women, long before outward signs appear, by testing blood and urine samples.

Pros:

- Several medical procedures or medications could cause harm to a pregnant woman or her fetus.
- If a woman is unable to communicate with medical staff (example: an unconscious victim of a road accident) pregnancy testing could save women and their fetuses from harm.
- Doctors are less likely to risk malpractice, should they perform surgery without knowing whether a woman is pregnant.

Cons:

- This could be viewed as an abuse of privacy, or against a woman's wishes for personal or religious reasons.
- A woman could feel insulted by this, especially if she has already been asked whether she could be pregnant.

Activity 3: Deciding when to use Screening Programmes

Advice Cards:

Prostate cancer screening programmes

Current NICE Guidelines do not recommend a prostate cancer screening programme inviting men for regular scans.

Until there is clear evidence to show that a national screening programme will bring more benefit than harm, the NHS will not be inviting men who have no symptoms for prostate cancer screening.

Home HIV tests

The use of home-based HIV testing kits is currently illegal in the United Kingdom.

HIV testing, offered by the NHS, usually takes at least two weeks to get results back. While these tests can be done anonymously at sexual health clinics, results are only released to patients in person. Currently one minute HIV tests are available at private clinics, and by charitable groups such as the Terrence Higgins Trust which promote HIV awareness and treatment, as well as some specialized NHS centres catering to groups at high risk of exposure to HIV.

NICE guidance encourages protected funding for charities that provide HIV testing and support to vulnerable people. The NICE guidelines also emphasise the role of support workers who help and advise people who are newly diagnosed with HIV.

DIY liver function kits

These are not endorsed by NICE or available on the NHS for patients who are healthy. However, several private clinics offer them as part of a set of 'Body MOT' tests.

Liver function tests are often performed to monitor patients with liver diseases, or patients who are taking potentially liver-damaging medicines. They are also available on the recommendation of a GP.

Breast cancer screening by mammography in younger women (under age 50)

The NHS currently invites women between 50 and 70 to be screened for breast cancer.

This is the age group when screening is most likely to give accurate images, and it is also the age range where the greatest number of breast cancers occurs.

However, women (or men) of any age who find lumps in their breasts are encouraged to see their GP, who will refer them to a radiography unit to examine anything that seems suspicious.

Compulsory pregnancy tests in all women before surgery/prescribing medication

NICE guidance for the NHS currently lists several medicines and operations that may harm a fetus. These include procedures such as examination by X-ray photography, and medicines such as the antibiotic tetracycline.

The guidance recommends that all women of reproductive age are given compulsory pregnancy tests before they receive these treatments.