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Health safety security hygiene

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CONTENTS

Chapter 1

Health

Health is the level of functional or metabolic efficiency of a living organism. In humans, it is the general condition of a person's mind and body, usually meaning to be free from illness, injury or pain (as in "good health" or "healthy"). The World Health Organization (WHO) defined health in its broader sense in 1946 as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." Although this definition has been subject to controversy, in particular as lacking operational value and because of the problem created by use of the word "complete," it remains the most enduring. Other definitions have been proposed, among which a recent definition that correlates health and personal satisfaction. Classification systems such as the WHO Family of International Classifications, including the International Classification of Functioning, Disability and Health (ICF) and the International Classification of Diseases (ICD), are commonly used to define and measure the components of health.

Systematic activities to prevent or cure health problems and promote good health in humans are undertaken by health care providers. Applications with regard to animal health are covered by the veterinary sciences. The term "healthy" is also widely used in the context of many types of non-living organizations and their impacts for the benefit of humans, such as in the sense of healthy communities, healthy cities or healthy environments. In addition to health care interventions and a person's surroundings, a number of other factors are known to influence the health status of individuals, including their background, lifestyle, and economic and social conditions; these are referred to as "determinants of health." Studies have shown that high levels of stress can affect your health.

Determinants of health

Generally, the context in which an individual lives is of great importance for his health status and quality of life. It is increasingly recognized that health is maintained and improved not only through the advancement and application of health science, but also through the efforts and intelligent lifestyle choices of the individual and society. According to the World Health Organization, the main determinants of health include the social and economic environment, the physical environment, and the person's individual characteristics and behaviors.

More specifically, key factors that have been found to influence whether people are healthy or unhealthy include:

- Income and social status
- Social support networks
- Education and literacy
- Employment/working conditions
- Social environments
- Physical environments
- Personal health practices and coping skills
- Healthy child development
- Biology and genetics
- Health care services
- Gender
- Culture

Donald Henderson as part of the CDC's smallpox eradication team in 1966.

An increasing number of studies and reports from different organizations and contexts examine the linkages between health and different factors, including lifestyles, environments, health care organization, and health policy – such as the 1974 Lalonde report from Canada; the Alameda County Study in California; and the series of World Health Reports of the World Health Organization, which focuses on global health issues including access to health care and improving public health outcomes, especially in developing countries.

The concept of the "health field," as distinct from medical care, emerged from the Lalonde report from Canada. The report identified three interdependent fields as key determinants of an individual's health. These are:

- Lifestyle: the aggregation of personal decisions (i.e., over which the individual has control) that can be said to contribute to, or cause, illness or death;
- Environmental: all matters related to health external to the human body and over which the individual has little or no control;
- Biomedical: all aspects of health, physical and mental, developed within the human body as influenced by genetic make-up.

The maintenance and promotion of health is achieved through different combination of physical, mental, and social well-being, together sometimes referred to as the "health triangle." The WHO's 1986 Ottawa Charter for Health Promotion further stated that health is not just a state, but also "a resource for everyday life, not the objective of living. Health is a positive concept emphasizing social and personal resources, as well as physical capacities."

Focusing more on lifestyle issues and their relationships with functional health, data from the Alameda County Study suggested that people can improve their health via exercise, enough sleep, maintaining a healthy body weight, limiting alcohol use, and avoiding smoking. The ability to adapt and to self manage have been suggested as core components of human health.

The environment is often cited as an important factor influencing the health status of individuals. This includes characteristics of the natural environment, the built environment, and the social environment. Factors such as clean water and air, adequate housing, and safe communities and roads all have been found to contribute to good health, especially to the health of infants and children. Some studies have shown that a lack of neighborhood recreational spaces including natural environment leads to lower levels of personal satisfaction and higher levels of obesity, linked to lower overall health and well being. This suggests that the positive health benefits of natural space in urban neighborhoods should be taken into account in public policy and land use.

Genetics, or inherited traits from parents, also play a role in determining the health status of individuals and populations. This can encompass both the predisposition to certain diseases and health conditions, as well as the habits and behaviors individuals develop through the lifestyle of their families. For example, genetics may play a role in the manner in which people cope with stress, either mental, emotional or physical (One difficulty is the issue raised by the debate over

the relative strengths of genetics and other factors; interactions between genetics and environment may be of particular importance.).

Mental health

The World Health Organization describes mental health as "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community". Mental Health is not just the absence of mental illness.

Mental illness is described as 'the spectrum of cognitive, emotional, and behavioural conditions that interfere with social and emotional wellbeing and the lives and productivity of people. Having a mental illness can seriously impair; temporarily or permanently, the mental functioning of a person. Other terms include: 'mental health problem', 'illness', 'disorder', 'dysfunction'. (Hungerford et al. 2012).

Roughly a quarter of all adults 18 and over in the US suffer from a diagnosable mental illness. Mental illnesses are the leading cause of disability in the US and Canada. Examples include, schizophrenia, ADHD, major depressive disorder, bipolar disorder, anxiety disorder, post-traumatic stress disorder and autism.

Maintaining health

Achieving and maintaining health is an ongoing process, shaped by both the evolution of health care knowledge and practices as well as personal strategies and organized interventions for staying healthy known as Lifestyle Management.

Role of science in health

Health science is the branch of science focused on health. There are two main approaches to health science: the study and research of the body and health-related issues to understand how humans (and animals) function, and the application of that knowledge to improve health and to prevent and cure diseases and other physical and mental impairments. The science builds on many sub-fields, including biology, biochemistry, physics,epidemiology, pharmacology, medical sociology. Applied health sciences endeavor to better understand and improve human health through applications in areas such as health education, biomedical engineering, biotechnology and public health.

Organized interventions to improve health based on the principles and procedures developed through the health sciences are provided by practitioners trained in medicine, nursing, nutrition, pharmacy, social work, psychology, occupational therapy, physical therapy and other health care professions. Clinical practitioners focus mainly on the health of individuals, while public health practitioners consider the overall health of communities and populations. Workplace wellness programs are increasingly adopted by companies for their value in improving the health and well-being of their employees, as are school health services to improve the health and well-being of children.

Role of public health

Postage stamp, New Zealand, 1933. Public health has been promoted – and depicted – in a wide variety of ways.

Public health has been described as "the science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals." It is concerned with threats to the overall health of a community based on population health analysis. The population in question can be as small as a handful of people or as large as all the inhabitants of several continents (for instance, in the case of a pandemic). Public health has many sub-fields, but typically includes the interdisciplinary categories of epidemiology, biostatistics and health services. Environmental health, community health, behavioral health, and occupational health are also important areas of public health.

The focus of public health interventions is to prevent and manage diseases, injuries and other health conditions through surveillance of cases and the promotion of healthy behavior, communities, and (in aspects relevant to human health) environments. Its aim is to prevent health problems from happening or re-occurring by implementing educational programs, developing policies, administering services, and conducting research. In many cases, treating a disease or controlling a pathogen can be vital to preventing it in others, such as during an outbreak. Vaccination programs and distribution of condoms to prevent the spread of communicable diseases are examples of common preventive public health measures, as are educational campaigns to promote vaccination and the use of condoms (including overcoming resistance to such).

Public health also takes various actions to limit the health disparities between different areas of the country and, in some cases, the continent or world. One issue is the access of individuals and communities to health care in terms of financial, geographical or socio-cultural constraints to accessing and using services. Applications of the public health system include the areas of maternal and child health, health services administration, emergency response, and prevention and control of infectious and chronic diseases.

The great positive impact of public health programs is widely acknowledged. Due in part to the policies and actions developed through public health, the 20th century registered a decrease in the mortality rates for infants and children and a continual increase in life expectancy in most parts of the world. For example, it is estimated that life expectancy has increased for Americans by thirty years since 1900, and worldwide by six years since 1990.

Self-care strategies

A lady washing her hands c. 1655

Personal health depends partially on the active, passive, and assisted cues people observe and adopt about their own health. These include personal actions for preventing or minimizing the effects of a disease, usually a chronic condition, through integrative care. They also include personal hygiene practices to prevent infection and illness, such as bathing and washing hands with soap; brushing and flossing teeth; storing, preparing and handling food safely; and many others. The information gleaned from personal observations of daily living – such as about sleep patterns, exercise behavior, nutritional intake, and environmental features – may be used to inform personal decisions and actions (e.g., "I feel tired in the morning so I am going to try sleeping on a different pillow"), as well as clinical decisions and treatment plans (e.g., a patient who notices his or her shoes are tighter than usual may be having exacerbation of left-sided heart failure, and may require diuretic medication to reduce fluid overload).

Personal health also depends partially on the social structure of a person's life. The maintenance of strong social relationships, volunteering, and other social activities have been linked to positive mental health and even increased longevity. One American study among seniors over age 70, found that frequent volunteering was associated with reduced risk of dying compared with older persons who did not volunteer, regardless of physical health status. Another study from Singapore reported that volunteering retirees had significantly better cognitive performance scores, fewer depressive symptoms, and better mental well-being and life satisfaction than non-volunteering retirees.

Prolonged psychological stress may negatively impact health, and has been cited as a factor in cognitive impairment with aging, depressive illness, and expression of disease.[30] Stress management is the application of methods to either reduce stress or increase tolerance to stress. Relaxation techniques are physical methods used to relieve stress. Psychological methods include cognitive therapy, meditation, and positive thinking, which work by reducing response to stress. Improving relevant skills, such as problem solving and time management skills, reduces uncertainty and builds confidence, which also reduces the reaction to stress-causing situations where those skills are applicable.

Occupational health

In addition to safety risks, many jobs also present risks of disease, illness, and other long-term health problems. Among the most common occupational diseases are various forms of pneumoconiosis, including silicosis and coal worker's pneumoconiosis (black lung disease). Asthma is another respiratory illness that many workers are vulnerable to. Workers may also be vulnerable to skin diseases, including eczema, dermatitis, urticaria, sunburn, and skin cancer. Other occupational diseases of concern include carpal tunnel syndrome and lead poisoning.

As the number of service sector jobs has risen in developed countries, more and more jobs have become sedentary, presenting a different array of health problems than those associated with manufacturing and the primary sector. Contemporary problems such as the growing rate of obesity and issues relating to stress and overwork in many countries have further complicated the interaction between work and health.

Many governments view occupational health as a social challenge and have formed public organizations to ensure the health and safety of workers. Examples of these include the British Health and Safety Executive and in the United States, the National Institute for Occupational Safety and Health, which conducts research on occupational health and safety, and the Occupational Safety and Health Administration, which handles regulation and policy relating to worker safety and health.

Chapter 2

Health and Safety Executive

Health and Safety Executive	
	
Non-departmental public body	
Crown status:	Unknown
Legal basis:	Health and Safety at Work etc. Act 1974, ss.10-11
Established:	1974
Sponsoring department:	Department for Work and Pensions
Current head:	Chair - Judith Hackitt; Chief Executive - Geoffrey Podger

The Health and Safety Executive (HSE) is a non-departmental public body of the United Kingdom with its headquarters in Liverpool, Merseyside, England. It is the body responsible for the encouragement, regulation and enforcement of workplace health, safety and welfare, and for research into occupational risks in England and Wales and Scotland. Responsibility in Northern Ireland lies with the Health and Safety Executive for Northern Ireland. The HSE was created by the Health and Safety at Work etc. Act 1974, and has since absorbed earlier regulatory bodies such as the Factory Inspectorate and the Railway Inspectorate though the Railway Inspectorate was transferred to the Office of Rail Regulation in April 2006. The HSE is sponsored by the Department for Work and Pensions. As part of its work HSE investigates industrial accidents, small and large, including major incidents such as the explosion and fire at Buncefield in 2005. Though it formerly reported to the Health and Safety Commission, on 1 April 2008, the two bodies merged.

Functions

The Executive's duties are to:

- Assist and encourage persons concerned with matters relevant to the operation of the objectives of the Health and Safety at Work etc. Act 1974.
- Make arrangements for and encourage research and publication, training and information in connection with its work.
- Make arrangements for securing government departments, employers, employees, their respective representative organisations, and other persons are provided with an information and advisory service and are kept informed of, and adequately advised on such matters.
- Propose regulations.

The Executive is further obliged to keep the Secretary of State informed of its plans and ensure alignment with the policies of the Secretary of State, giving effect to any directions given to it. The Secretary of State can give directions to the Executive.

On 1 April 2006, the Executive ceased to have responsibility for railway safety.

The Executive is responsible for the Employment Medical Advisory Service, which operates as part of its Field Operations Directorate. the site is a good place for help

Structure and responsibilities

Local authorities are responsible for the enforcement of health and safety legislation in shops, offices, and other parts of the service sector.

Agencies belonging to the HSE include

Explosives Inspectorate

HSE's Explosives Inspectorate enforces the legislation for the classification and transport of explosives. It licenses manufacturing and larger storage sites.

The Health and Safety Laboratory

Based in Buxton, Derbyshire, the Health and Safety Laboratory (HSL) employs over 350 people including scientists, engineers, psychologists, social scientists, health professionals and technical specialists.

It was established in 1921 under the Safety in Mines Research Board to carry out large-scale tests related to mining hazards. Following the formation of the HSE, in 1975 the facilities became a Safety Engineering Laboratory and an Explosion and Flame Research Laboratory,

operating as part of the Research Laboratories Service Division of the HSE. In 1995 the HSL was formed, including the Buxton site and laboratories in Sheffield. In 2004 the Sheffield activities moved to Buxton, and the University of Sheffield took over the Sheffield laboratory site.

It now operates as an agency carrying out scientific research and investigations (e.g. on the Buncefield fire) for the HSE, other government agencies and the private sector.

HM Inspectorate of Mines

HM Inspectorate of Mines is responsible for the correct implementation and inspection of safe working procedures within all UK mine workings. It is based in Sheffield, South Yorkshire.

Nuclear Directorate

The Nuclear Directorate was one of the bodies merged into the Office for Nuclear Regulation on 1 April 2011. Largely based in Bootle, the Nuclear Directorate had four main functions:

- nuclear safety and radioactive waste management of civilian and defence sites - Nuclear Installations Inspectorate
- security of civilian nuclear sites and nuclear transport - The Office for Nuclear Security (transferred to HSE April 2007)
- safeguarding civilian nuclear material to prevent diversion to weapons - UK Safeguards Office (transferred to HSE April 2007)
- a nuclear safety research programme

OSHCR (Occupational Safety & Health Consultants Register)

The HSE currently administrates the Occupational Safety & Health Consultants Register (OSHCR), a central register of registered safety consultants within the United Kingdom and Northern Ireland. The intention of the HSE is to pass responsibility of operating the register to the relevant trade & professional bodies once the register is up and running.

Criticism

The HSE has been criticised. Some of the criticism has been that its procedures are inadequate to protect safety. For example, the public enquiry by Lord Gill into the Stockline Plastics factory explosion criticised the HSE for "inadequate appreciation of the risks associated with buried LPG pipework ... and a failure properly to carry out check visits". However, most criticism of the HSE is that their regulations are over-broad, suffocating, and part of a nanny state. The Daily

Telegraph has claimed that the HSE is part of a "compensation culture," that it is undemocratic and unaccountable, and that its rules are costing jobs.

However, the HSE denies this, saying that much of the criticism is misplaced because it relates to matters outside the HSE's remit. The HSE also responded to criticism by publishing a "Myth of the Month" section on its website between 2007 and 2010, which it described as "exposing the various myths about ‘health and safety’". This has become a political issue in the UK. The Lord Young report, published in October 2010, recommended various reforms aiming "to free businesses from unnecessary bureaucratic burdens and the fear of having to pay out unjustified damages claims and legal fees."

Areas of regulation

The HSE focuses regulation of health and safety in the following sectors of industry:

- Agriculture
- Air transport
- Armed forces
- Catering and hospitality
- Construction industries
- Crown establishments
- Chemical manufacture and storage industries
- Professional diving
- Dock work
- Education sector e.g. schools
- Engineering sector
- Entertainment and leisure industry
- Fire service
- Food and drink manufacture
- Footwear and leather industries
- Haulage
- Health Services e.g. hospitals
- Gas supply and installation; Gas Safe Register
- Laundries and dry-cleaning

- Mining
- Motor vehicle repair
- Nuclear installations; Nuclear Installations Inspectorate (aka NII)
- Office work
- Offshore Oil and Gas Installations
- Paper and board manufacturing industry
- Pesticides
- Police force
- Printing industries
- Public services
- The quarry industry
- Recycling and waste management industries
- Textiles industries

4 parts of health

Emotional health

Emotional health is the way in which you express your feelings. People who are emotionally healthy usually do the following:

Express their emotions in healthy ways. Deal with sadness and ask for help if they need to. Accept both their strengths and weaknesses.

Mental health

Mental health is the way that you cope with the demands of daily life. People who have good mental health usually have the following characteristics: the ability to handle stress effectively and to solve problems and the ability to adjust to change.

Social health

Social health is the way you interact with people. The four parts of your health are equally important to your overall wellness.

Wellness

Wellness is a state of good health that is achieved by balancing your physical, emotional, mental, and social health.

Chapter 3
Health and safety

We have a responsibility to ensure the health, safety, welfare and security of all our students, staff, visitors and members of the public who use the College premises and its resources. We will seek to minimise risk at all times. It is important that you feel safe whilst you are in college. General health and safety awareness will form part of the induction of all student groups and staff. You will also receive ongoing specific health and safety training and instruction as appropriate to your course of study. If you have an accident on college premises, report it to your tutor or reception immediately.

If you have any health and safety concerns, or see any potential hazards at college, talk to your tutor or report it to reception. Please do not assume that someone else will already have reported it – it is better that we receive several reports than none. You can make suggestions for improvements to health and safety standards in the College through student representatives and make use of the Learner Voice Representatives at each campus.

It is very important that you conduct yourself in such a way as to avoid putting yourself and other people at unnecessary risk at college, or when taking part in off-site events organised by the College. This includes following instructions that have been given to ensure the safety of an activity and not damaging or interfering with safety equipment. We strive to provide a stimulating learning experience in a safe and healthy college environment.

Security

We take the security of you and your belongings very seriously. We need you to help us make sure that ncn stays a secure and friendly place for all students. For safety reasons we will ask to see your ID card regularly. Keep your ID card safe and never lend it to anyone. You are responsible for the safe keeping of your property, such as purses, mobile phones and bags – keep these with you at all times and never leave them unattended in a public area or classroom. We are not responsible for the loss or theft of your belongings whilst you are at college.

You park your car at college at your own risk and we will not be responsible for any damage or theft whilst you are with us.

You may sometimes need to take equipment out of college. Make sure that you have the written consent of your tutor beforehand or you may be stopped and could be suspended from college.
Finally, if you think that you have lost something or have had something stolen whilst you are in college, or see someone acting suspiciously, contact your nearest security office or reception immediately.

Health and safety at work

1. Employers: preventing discrimination

Discrimination policy and equal opportunities in the workplace - sex discrimination, disabled workers, older people, compulsory retirement

What discrimination is

It is against the law to treat someone less favourably than someone else because of a personal characteristic, eg religion or age. There are different kinds of discrimination.

It can include, for example:

- not hiring someone
- selecting a particular person for redundancy
- paying someone less than another worker without good reason

Discrimination does not have to be deliberate and intentional. You can discriminate indirectly with working conditions or rules that disadvantage one group of people more than another.

2. Recruitment

Job adverts

You mustn't state or imply in a job advert that you'll discriminate against anyone. This includes saying that you aren't able to cater for workers with a disability. Only use phrases like 'recent graduate' or 'highly experienced' when these are actual requirements of the job. This could discriminate against younger or older people who might not have had the opportunity to get certain qualifications.

Where you advertise might cause indirect discrimination - for example, advertising only in men's magazines.

Date of birth

You shouldn't ask someone for their date of birth on an application form. People selecting candidates for interview or interviewing shouldn't be influenced by someone's age. You can include a question on date of birth as part of an equality monitoring form if you use one.

Criminal convictions

Applicants don't have to tell you about criminal convictions if they're spent. You must treat the applicant as if the conviction has not happened, and cannot refuse to employ the person because of their conviction.

There are some areas of employment that are exempt from this rule, eg schools.

Trade union membership

You must not use membership of a trade union as a factor in deciding whether to employ someone. This includes:

- not employing someone because they're a member of a trade union
- insisting someone joins a trade union before you'll employ them

Employing people with protected characteristics

You can choose a job candidate who has a protected characteristic over one who doesn't if they're as suitable for the job and you think that people with that characteristic:

- are underrepresented in the workforce, profession or industry
- suffer a disadvantage connected to that characteristic (eg people from a certain ethnic group are not often given jobs in your sector)

You can only do this if you're trying to address the under-representation or disadvantage for that particular person. You must make decisions on a case by case basis and not because of a certain policy.

You can't choose a candidate who isn't as suitable for the job just because they have a protected characteristic.

Disabled people

When recruiting you can treat a disabled person more favourably than a non-disabled person because of their disability.

Equal pay

Women and men are entitled to be paid equal amounts for work of equal value - including benefits, e.g. company car.

3. Fire safety in the workplace

Fire safety in business and non-domestic premises: the responsible person, fire risk assessments, shared premises, new buildings, enforcement, appeals and penalties

Who is responsible

In England and Wales, if you're an employer, owner, landlord or occupier of business or other non-domestic premises, you're responsible for fire safety and are known as the 'responsible person'.

As the responsible person, there are certain things you must do by law under the Fire Safety Order, which is enforced by your local fire and rescue authority.

The Fire Safety Order also applies if you have paying guests - eg if you run a bed and breakfast, guest house or let self-catering property.

Fire risk assessments

The 'responsible person' must carry out and regularly review a fire risk assessment of the premises. This will identify what you need to do to prevent fire and keep people safe. You must keep a written record of your fire risk assessment if your business has 5 or more people.

Carrying out the assessment

i. Identify the fire hazards.
ii. Identify people at risk.
iii. Evaluate, remove or reduce the risks.
iv. Record your findings, prepare an emergency plan and provide training.
v. Review and update the fire risk assessment regularly.

The fire safety risk assessment chart gives more detailed information about these steps.

You'll need to consider:

- emergency routes and exits
- fire detection and warning systems
- fire fighting equipment
- the removal or safe storage of dangerous substances
- an emergency fire evacuation plan

- the needs of vulnerable people, eg the elderly, young children or those with disabilities
- providing information to employees and other people on the premises
- staff fire safety training

Help with the assessment

The responsible person can do the fire risk assessment themselves with the help of standard fire safety advice documents.

If you don't have the expertise or time to do the fire risk assessment yourself you'll need to appoint a 'competent person' to help, eg a professional risk assessor.

If you're not sure if your risk assessment has been carried out properly your local fire and rescue authority might be able to give you advice although they can't carry out risk assessments for you.

Fire safety and evacuation plans

Your plan must show how you have:

- a clear passageway to all escape routes
- clearly marked escape routes that are as short and direct as possible
- enough exits and routes for all people to escape
- emergency doors that open easily
- emergency lighting where needed
- training for all employees to know and use the escape routes
- a safe meeting point for staff

People with mobility needs

You should also make special arrangements for people with mobility needs, e.g. make sure there are specific people to help wheelchair users get downstairs if there's a fire.

Fire safety equipment, drills and training

Fire detection and warning systems

You must have a fire-detection and warning system. You may need different types of detectors, depending on the type of building and work carried out in the building.

Fire fighting equipment

The types of equipment you need depend on your business premises. You'll need to have any equipment properly installed, tested and maintained and train your staff to use them if necessary.

Maintenance and testing

You must carry out regular checks to make sure that:

- all fire alarm systems are working
- the emergency lighting is working
- you record any faults in systems and equipment
- all escape routes are clear and the floor is in a good state
- all fire escapes can be opened easily
- automatic fire doors close correctly
- fire exit signs are in the right place

Fire drills and training

You need to train new staff when they start work and tell all employees about any new fire risks.

You should carry out at least 1 fire drill per year and record the results. The results should be kept as part of your fire safety and evacuation plan.

Enforcement, appeals and penalties

Your local fire and rescue authority visits premises to check the fire risk assessment and fire prevention measures are appropriate. Fire safety officers should help you understand the rules and help you comply with them.

They can also take action if they think your fire safety measures aren't adequate. For example, they might issue an informal notice suggesting changes you should consider making to make your premises safer.

They could also give you one of several different formal fire safety notices. The fire and rescue authority will tell you what you need to do to fix the problems given in the notice.

Alterations notice

You could get an alterations notice if your premises has high safety risks or will have high safety risks if the use of the premises changes.

Enforcement notice

You could get an enforcement notice if the fire and rescue authority finds a serious risk that's not being managed. It will say what improvements are needed and by when.

Prohibition notice

These take effect immediately if the fire and rescue authority thinks that the fire risk is so great that access to your premises needs to be prohibited or restricted.

Appeals

You may be able to arrange an informal review from your fire and rescue authority if you disagree with the decision to issue a fire safety notice.

If you've already got the notice, you can appeal to your local magistrates' court within 21 days.

In certain circumstances, you and the fire and rescue authority can ask for a 'determination' from the Communities Secretary to solve a dispute.

4. Health and Safety Executive (HSE)

Contact information for finding out about health and safety at work issues and making a complaint and reporting injuries

5. Health and safety on ships

Owners and operators of seagoing ships and large yachts are responsible for the health and safety of seafarers

If you operate a seagoing ship or small commercial vessel, you must protect the health and safety of your workers by:

- following safety standards and codes of practice
- ensuring the safety of machinery and equipment
- making sure that your vessel is safely manned and that all workers have the necessary qualifications
- having the right emergency procedures and equipment
- providing health protection and medical care for your workers
- doing regular risk assessments
- supplying any necessary protective clothing and equipment

- monitoring maritime safety information broadcasts
- consulting with your workers or their representatives on health and safety matters

6. Health and safety using farm vehicles and machinery

Your legal obligations to ensure the health, safety and welfare of your farm employees and workers.

If you own or manage a farm, you're responsible for ensuring the health and safety of your workers and anyone who's affected by what they do.

You must:

- carry out a assessment of any risks related to your farm
- have a plan to manage these risks and protect people from harm
- plan and set standards to be sure that your health and safety practices work
- check how you're doing through regular inspections and monitoring

You must make sure that all farming vehicles and equipment are:

- safe to use
- appropriate for the jobs they are used for
- their safety risks are reduced as much as possible

7. Smoking at work: the law

The law on smoking in the workplace and what businesses must do to prevent smoking at work

8. Workplace temperatures

There is no law for a minimum or maximum temperature, but during working hours the temperature in all workplaces inside buildings must be reasonable

Chapter 4
Occupational health

Occupational safety and health is an area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goals of occupational safety and health programs include to foster a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment.

Occupational safety and health can be important for moral, legal, and financial reasons. All organisations have a duty of care to ensure that employees and any other person who may be affected by the companies undertaking remain safe at all times. Moral obligations would involve the protection of employee's lives and health. Legal reasons for OSH practices relate to the preventative, punitive and compensatory effects of laws that protect worker's safety and health. OSH can also reduce employee injury and illness related costs, including medical care, sick leave and disability benefit costs. OSH may involve interactions among many subject areas, including occupational medicine, occupational hygiene, public health, safety engineering, industrial engineering, chemistry, health physics, industrial and organizational psychology, ergonomics, and occupational health psychology.

Definition

Since 1950, the International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. It was adopted by the Joint ILO/WHO Committee on Occupational Health at its first session in 1950 and revised at its twelfth session in 1995. The definition reads:

"Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarize, the adaptation of work to man and of each man to his job.

"The main focus in occupational health is on three different objectives: (i) the maintenance and promotion of workers' health and working capacity; (ii) the improvement of working environment and work to become conducive to safety and health and (iii) development of work organizations and working cultures in a direction which supports health and safety at work and in doing so also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies and quality management of the undertaking."

History

The research and regulation of occupational safety and health are a relatively recent phenomenon. As labor movements arose in response to worker concerns in the wake of the industrial revolution, worker's health entered consideration as a labor-related issue.

In 1833, HM Factory Inspectorate was formed in the United Kingdom with a remit to inspect factories and ensure the prevention of injury to child textile workers.

In 1840 a Royal Commission published its findings on the state of conditions for the workers of the mining industry that documented the appallingly dangerous environment that they had to work in and the high frequency of accidents. The commission sparked public outrage which resulted in the Mines Act of 1842. The act set up an inspectorate for mines and collieries which resulted in many prosecutions and safety improvements, and by 1850, inspectors were able to enter and inspect premises at their discretion.

Harry McShane, age 16, 1908. Pulled into machinery in a factory in Cincinnati. His arm was ripped off at the shoulder and his leg broken. No compensation paid. Photograph by Lewis Hine.

Otto von Bismarck inaugurated the first social insurance legislation in 1883 and the first worker's compensation law in 1884 – the first of their kind in the Western world. Similar acts followed in other countries, partly in response to labor unrest.

Workplace hazards

Physical and mechanical hazards

Physical hazards are a common source of injuries in many industries. They are perhaps unavoidable in many industries such as construction and mining, but over time people have developed safety methods and procedures to manage the risks of physical danger in the workplace. Employment of children may pose special problems.

Falls are a common cause of occupational injuries and fatalities, especially in construction, extraction, transportation, healthcare, and building cleaning and maintenance.

An engineering workshop specialising in the fabrication and welding of components has to follow the Personal Protective Equipment (PPE) at work regulations 1992. It is an employers duty to provide ‘all equipment (including clothing affording protection against the weather) which is intended to be worn or held by a person at work which him against one or more risks to his health and safety’. In a fabrication and welding workshop an employer would be required to provide face and eye protection, safety footwear, overalls and other necessary PPE.

Machines are commonplace in many industries, including manufacturing, mining, construction and agriculture, and can be dangerous to workers. Many machines involve moving parts, sharp edges, hot surfaces and other hazards with the potential to crush, burn, cut, shear, stab or otherwise strike or wound workers if used unsafely. Various safety measures exist to minimize these hazards, including lockout-tagout procedures for machine maintenance and roll over

protection systems for vehicles. According to the United States Bureau of Labor Statistics, machine-related injuries were responsible for 64,170 cases that required days away from work in 2008. More than a quarter of these cases required more than 31 days spent away from work. That same year, machines were the primary or secondary source of over 600 work-related fatalities. Machines are also often involved indirectly in worker deaths and injuries, such as in cases in which a worker slips and falls, possibly upon a sharp or pointed object. The transportation sector bears many risks for the health of commercial drivers, too, for example from vibration, long periods of sitting, work stress and exhaustion. These problems occur in Europe but in other parts of the world the situation is even worse. More drivers die in accidents due to security defects in vehicles. Long waiting times at borders cause that drivers are away from home and family much longer and even increase the risk of HIV infections.

Confined spaces also present a work hazard. The National Institute of Occupational Safety and Health defines "confined space" as having limited openings for entry and exit and unfavorable natural ventilation, and which is not intended for continuous employee occupancy. These kind of spaces can include storage tanks, ship compartments, sewers, and pipelines. Confined spaces can pose a hazard not just to workers, but also to people who try to rescue them.

Noise also presents a fairly common workplace hazard: occupational hearing loss is the most common work-related injury in the United States, with 22 million workers exposed to hazardous noise levels at work and an estimated $242 million spent annually on worker's compensation for hearing loss disability. Noise is not the only source of occupational hearing loss; exposure to chemicals such as aromatic solvents and metals including lead, arsenic, and mercury can also cause hearing loss.

Temperature extremes can also pose a danger to workers. Heat stress can cause heat stroke, exhaustion, cramps, and rashes. Heat can also fog up safety glasses or cause sweaty palms or dizziness, all of which increase the risk of other injuries. Workers near hot surfaces or steam also are at risk for burns. Dehydration may also result from overexposure to heat. Cold stress also poses a danger to many workers. Overexposure to cold conditions or extreme cold can lead to hypothermia, frostbite, trench foot, or chilblains.

Electricity poses a danger to many workers. Electrical injuries can be divided into four types: fatal electrocution, electric shock, burns, and falls caused by contact with electric energy.

Vibrating machinery, lighting, and air pressure can also cause work-related illness and injury. Asphyxiation is another potential work hazard in certain situations. Musculoskeletal disorders are avoided by the employment of good ergonomic design and the reduction of repeated strenuous movements or lifts

Biological and chemical hazards

Biological hazards

- Bacteria
- Virus
- Fungi
- Mold
- Blood-borne pathogens
- Tuberculosis

Chemical hazards

- Acids
- Bases
- Heavy metals
- Lead
- Solvents
- Petroleum
- Particulates
- Asbestos and other fine dust/fibrous materials
- Silica
- Fumes (noxious gases/vapors)
- Highly-reactive chemicals
- Fire, conflagration and explosion hazards:
- Explosion
- Deflagration
- Detonation
- Conflagration

Psychosocial hazards

Psychosocial hazards are related to the way work is designed, organised and managed, as well as the economic and social contexts of work and are associated with psychiatric, psychological and/or physical injury or illness.

- Work-related see stress, occupational stress
- Excessive working time and overwork
- Violence from outside the organization
- Bullying, which may include emotional and verbal abuse
- Sexual harassment
- Mobbing
- Burnout
- Exposure to unhealthy elements during meetings with business associates, e.g. tobacco, uncontrolled alcohol

Occupational safety and health by industry

Specific occupational safety and health concerns vary greatly by sector and industry. Construction workers might be particularly at risk of falls, for instance, whereas fishermen might be particularly at risk of drowning. The United States Bureau of Labor Statistics identifies the fishing, aviation, lumber, metalworking,agriculture, mining and transportation industries as among some of the more dangerous for workers.

Construction

Construction is one of the most dangerous occupations in the world, incurring more occupational fatalities than any other sector in both the United States and in the European Union. In 2009, the fatal occupational injury rate among construction workers in the United States was nearly three times that for all workers. Falls are one of the most common causes of fatal and non-fatal injuries among construction workers. Proper safety equipment such as harnesses and guardrails and procedures such as securing ladders and inspecting scaffolding can curtail the risk of occupational injuries in the construction industry. Due to the fact that accidents may have disastrous consequences for employees as well as organizations, it is of utmost importance to ensure health and safety of workers and compliance with HSE construction requirements. Health and safety legislation in the construction industry involves many rules and regulations. For

example, the role of the Construction Design Management (CDM) Coordinator as a requirement has been aimed at improving health and safety on-site.

The 2010 National Health Interview Survey Occupational Health Supplement (NHIS-OHS) identified work organization factors and occupational psychosocial and chemical/physical exposures which may increase some health risks. Among all U.S. workers in the construction sector, 44% had non-standard work arrangements (were not regular permanent employees) compared to 19% of all U.S. workers, 15% had temporary employment compared to 7% of all U.S. workers, and 55% experienced job insecurity compared to 32% of all U.S. workers. Prevalence rates for exposure to physical/chemical hazards were especially high for the construction sector. Among nonsmoking workers, 24% of construction workers were exposed to secondhand smoke while only 10% of all U.S. workers were exposed. Other physical/chemical hazards with high prevalence rates in the construction industry were frequently working outdoors (73%) and frequent exposure to vapors, gas, dust, or fumes (51%).

Agriculture

Rollover protection bar on a Fords on tractor.

Agriculture workers are often at risk of work-related injuries, lung disease, noise-induced hearing loss, skin disease, as well as certain cancers related to chemical use or prolonged sun exposure. On industrialized farms, injuries frequently involve the use of agricultural machinery. The most common cause of fatal agricultural injuries in the United States is tractor rollovers, which can be prevented by the use of roll over protection structures which limit the risk of injury in case a tractor rolls over. Pesticides and other chemicals used in farming can also be hazardous to worker health, and workers exposed to pesticides may experience illnesses or birth defects. As an industry in which families, including children, commonly work alongside their families,

agriculture is a common source of occupational injuries and illnesses among younger workers. Common causes of fatal injuries among young farm worker include drowning, machinery and motor vehicle-related accidents.

The 2010 NHIS-OHS found elevated prevalence rates of several occupational exposures in the agriculture, forestry, and fishing sector which may negatively impact health. These workers often worked long hours. The prevalence rate of working more than 48 hours a week among workers employed in these industries was 37%, and 24% worked more than 60 hours a week. Of all workers in these industries, 85% frequently worked outdoors compared to 25% of all U.S. workers. Additionally, 53% were frequently exposed to vapors, gas, dust, or fumes, compared to 25% of all U.S. workers.

Service sector

As the number of service sector jobs has risen in developed countries, more and more jobs have become sedentary, presenting a different array of health problems than those associated with manufacturing and the primary sector. Contemporary problems such as the growing rate of obesity and issues relating to stress and overwork in many countries have further complicated the interaction between work and health.

According to data from the 2010 NHIS-OHS, hazardous physical/chemical exposures in the service sector were lower than national averages. On the other hand, potentially harmful work organization characteristics and psychosocial workplace exposures were relatively common in this sector. Among all workers in the service industry, 30% experienced job insecurity in 2010, 27% worked non-standard shifts (not a regular day shift), 21% had non-standard work arrangements (were not regular permanent employees).

Mining and oil & gas extraction

According to data from the 2010 NHIS-OHS, workers employed in mining and oil & gas extraction industries had high prevalence rates of exposure to potentially harmful work organization characteristics and hazardous chemicals. Many of these workers worked long hours: 50% worked more than 48 hours a week and 25% worked more than 60 hours a week in 2010. Additionally, 42% worked non-standard shifts (not a regular day shift). These workers also had high prevalence of exposure to physical/chemical hazards. In 2010, 39% had frequent skin contact with chemicals. Among nonsmoking workers, 28% of those in mining and oil and gas

extraction industries had frequent exposure to secondhand smoke at work. About two-thirds were frequently exposed to vapors, gas, dust, or fumes at work.

Management systems

International

In 2001, the International Labor Organization (ILO) published ILO-OSH 2001, also titled "Guidelines a on occupational safety and health management systems" to assist organizations with introducing OSH management systems. These guidelines encourage continual improvement in employee health and safety, achieved via a constant process of policy, organization, planning & implementation, evaluation, and action for improvement, all supported by constant auditing to determine the success of OSH actions.

The ILO management system was created to assist employers to keep pace with rapidly shifting and competitive industrial environments. The ILO recognizes that national legislation is essential, but sometimes insufficient on its own to address the challenges faced by industry, and therefore elected to ensure free and open distribution of administrative tools in the form of occupational health and safety management system guidance for everyone. This open access forum is intended to provide the tools for industry to create safe and healthy working environments and foster positive safety cultures within the organizations

OHSAS 18000 is an international occupational health and safety management system specification developed by the London-based BSI Group, a multinational business chiefly concerned with the production and distribution of standards related services. OHSAS 18000 comprises two parts, OHSAS 18001 and 18002 and embraces a number of other publications. OHSAS 18000 is the internationally recognized assessment specification for occupational health and safety management systems. It was developed by a selection of leading trade bodies, international standards and certification bodies to address a gap where no third-party certifiable international standard exists. This internationally recognized specification for occupational health and safety management system operates on the basis of policy, planning, implementation and operation, checking and corrective action, management review, and continual improvement.

The British Standards – Occupational Health and Safety management Systems Requirements Standard BS OHSAS 18001 was developed within the framework of the ISO standards series. Allowing it to integrate better into the larger system of ISO certifications. ISO 9001 Quality

Management Systems and ISO 14001 Environmental Management System can work in tandem with BS OHSAS 18001/18002 to complement each other and form a better overall system. Each component of the system is specific, auditable, and accreditable by a third party after review.
Also Standards Australia and the Association Française de Normalisation (AFNOR) in France have developed occupational safety and health management standards.

United Kingdom

Guidance note HSG65: Successful Health and Safety Management, published by the British non-departmental public body Health and Safety Executive, promotes a systematic management of health and safety through a six step system, policy, organizing, planning and implementing, measuring performance, reviewing performance. These components are all linked to an audit system providing for evaluation and a feedback loop to improve performance. This systematic approach allows flexibility for the company through good business planning to strategically apply resources according to risk priorities.

National legislation and public organizations

Occupational safety and health practice vary among nations with different approaches to legislation, regulation, enforcement, and incentives for compliance. In the EU, for example, some member states promote OSH by providing public monies as subsidies, grants or financing, while others have created tax system incentives for OSH investments. A third group of EU member states has experimented with using workplace accident insurance premium discounts for companies or organisations with strong OSH records.

Number of full-time OSH inspectors per 100,000 full-time employees	
Italy	17,7
Finland	17,5
Denmark	11,9
UK	11,1
Norway	10,6
Sweden	10
Belgium	5,3
Netherlands	4,8
Ireland	4,5
Greece	4,1
France	3,5
Spain	2,1

The number of OSH personnel employed to ensure compliance to OSH rules varies markedly between countries.

European Union

In the European Union, member states have enforcing authorities to ensure that the basic legal requirements relating to occupational health and safety are met. In many EU countries, there is strong cooperation between employer and worker organisations (e.g. unions) to ensure good OSH performance as it is recognized this has benefits for both the worker (through maintenance of health) and the enterprise (through improved productivity and quality). In 1996, the European Agency for Safety and Health at Work was founded.

Member states of the European Union have all transposed into their national legislation a series of directives that establish minimum standards on occupational health and safety. These directives (of which there are about 20 on a variety of topics) follow a similar structure requiring the employer to assess the workplace risks and put in place preventive measures based on a hierarchy of control. This hierarchy starts with elimination of the hazard and ends with personal protective equipment.

However, certain EU member states admit to having lacking quality control in occupational safety services, to situations in which risk analysis takes place without any on-site workplace

visits and to insufficient implementation of certain EU OSH directives. Based on this, it is hardly surprising that the total societal costs of work-related health problems and accidents vary from 2.6% to 3.8% of GNP between the EU member states.

United Kingdom

In the UK, health and safety legislation is drawn up and enforced by the Health and Safety Executive and local authorities (the local council) under the Health and Safety at Work etc. Act 1974. Increasingly in the UK the regulatory trend is away from prescriptive rules, and towards risk assessment. Recent major changes to the laws governing asbestos and fire safety management embrace the concept of risk assessment.

Denmark

In Denmark, occupational safety and health is regulated by the Danish Act on Working Environment and cooperation at the workplace. The Danish Working Environment Authority carries out inspections of companies, draws up more detailed rules on health and safety at work and provides information on health and safety at work. The result of each inspection is made public on the web pages of the Danish Working Environment Authority so that the general public, current and prospective employees, customers and other stakeholders can inform themselves about whether a given organization has passed the inspection, should they wish to do so.

United States

In the United States, the Occupational Safety and Health Act of 1970 created both the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration(OSHA). OSHA, in the U.S. Department of Labor, is responsible for developing and enforcing workplace safety and health regulations. NIOSH, in the U.S. Department of Health and Human Services, is focused on research, information, education, and training in occupational safety and health.

OSHA has been regulating occupational safety and health since 1971. Occupational safety and health regulation of a limited number of specifically defined industries was in place for several

decades before that, and broad regulations by some individual states was in place for many years prior to the establishment of OSHA.

Canada

In Canada, workers are covered by provincial or federal labour codes depending on the sector in which they work. Workers covered by federal legislation (including those in mining, transportation, and federal employment) are covered by the Canada Labour Code; all other workers are covered by the health and safety legislation of the province in which they work. The Canadian Centre for Occupational Health and Safety (CCOHS), an agency of the Government of Canada, was created in 1966 by an Act of Parliament. The act was based on the belief that all Canadians had "...a fundamental right to a healthy and safe working environment." CCOHS is mandated to promote safe and healthy workplaces to help prevent work-related injuries and illnesses. The CCOHS maintains a useful (partial) list of OSH regulations for Canada and its provinces.

Malaysia

In Malaysia, the Department of Occupational Safety and Health (DOSH) under the Ministry of Human Resource is responsible to ensure that the safety, health and welfare of workers in both the public and private sector is upheld. DOSH is responsible to enforce the Factories and Machinery Act 1967 and the Occupational Safety and Health Act 1994.

People's Republic of China

In the People's Republic of China, the Ministry of Health is responsible for occupational disease prevention and the State Administration of Work Safety for safety issues at work. On the provincial and municipal level, there are Health Supervisions for occupational health and local bureaus of Work Safety for safety. The "Occupational Disease Control Act of PRC" came into force on May 1, 2002. and Work safety Act of PRC on November 1, 2002. The Occupational Disease Control Act is under revising. The prevention of occupational disease is still in its initial stage compared with industried countries such as the US or UK.

South Africa

In South Africa the Department of Labour is responsible for occupational health and safety inspection and enforcement in commerce and industry apart from mining and energy production, where the Department of Mineral Resources is responsible.

The main statutory legislation on Health and Safety in the jurisdiction of the Department of Labour is Act No. 85 of 1993: Occupational Health and Safety Act as amended by Occupational Health and Safety Amendment Act, No. 181 Of 1993.

Regulations to the OHS Act include:

- Certificate of Competency Regulations, 1990
- Construction Regulations, 2003
- Diving Regulations 2009
- Driven Machinery Regulations, 1988
- Environmental Regulations for Workplaces, 1987
- General Machinery regulations, 1988
- General Safety Regulations, 1986
- Noise induced hearing loss regulations, 2003
- Pressure Equipment Regulations, 2004

Roles and responsibilities of OSH professionals

The roles and responsibilities of OSH professionals vary regionally, but may include evaluating working environments, developing, endorsing and encouraging measures that might prevent injuries and illnesses, providing OSH information to employers, employees, and the public, providing medical examinations, and assessing the success of worker health programs.

Europe

In Norway, the main required tasks of an Occupational Health and Safety Practitioner include:

- Systematic evaluations of the working environment
- Endorsing preventative measures which eliminate reasons for illnesses in the work place
- Giving information in the subject of employees' health
- Giving information on occupational hygiene, ergonomics and also environmental and safety risks in the work place

In the Netherlands, required tasks for health and safety staff are only summarily defined, and include:

- Voluntary medical examinations
- A consulting room on the work environment for the workers
- Health check assessments (if needed for the job concerned)

'The main influence on the Dutch law on the job of the safety professional is through the requirement on each employer to use the services of a certified working conditions service to advise them on health and safety'. A 'certified service' must employ sufficient numbers of four types of certified experts to cover the risks in the organisations which use the service:

- A safety professional
- An occupational hygienist
- An occupational physician
- A work and organisation specialist.

It shows in Table 1 (based on the European Network of Safety and Health Practitioner Organisations [ENHSPO] survey to) that in Norway, 37% of Health and Safety practitioners had a MSc education level, and 14% in the Netherlands; 44% were BSc graduates and 63% in the Netherlands; and 19% were of a Technician level and 23% in the Netherlands.

USA

Leather craftsman gloves, safety goggles, and a properly fitted hardhat are crucial for proper safety in a construction environment.

The main tasks undertaken by the OHS practitioner in the USA include:

- Develop processes, procedures, criteria, requirements, and methods to attain the best possible management of the hazards and exposures that can cause injury to people, and damage property, or the environment;
- Apply good business practices and economic principles for efficient use of resources to add to the importance of the safety processes;
- Promote other members of the company to contribute by exchanging ideas and other different approaches to make sure that every one in the corporation possess OHS knowledge and have functional roles in the development and execution of safety procedures;
- Assess services, outcomes, methods, equipment, workstations, and procedures by using qualitative and quantitative methods to recognise the hazards and measure the related risks;
- Examine all possibilities, effectiveness, reliability, and expenditure to attain the best results for the company concerned

Knowledge required by the OHS professional in USA include:

- Constitutional and case law controlling safety, health, and the environment
- Operational procedures to plan/develop safe work practices
- Safety, health and environmental sciences
- Design of hazard control systems (i.e. fall protection, scaffoldings)
- Design of recordkeeping systems that take collection into account, as well as storage, interpretation, and dissemination
- Mathematics and statistics
- Processes and systems for attaining safety through design

Some skills required by the OHS professional in the USA include (but are not limited to):

- Understanding and relating to systems, policies and rules
- Holding checks and having control methods for possible hazardous exposures
- Mathematical and statistical analysis
- Examining manufacturing hazards
- Planning safe work practices for systems, facilities, and equipment
- Understanding and using safety, health, and environmental science information for the improvement of procedures
- Interpersonal communication skills

Differences across countries and regions

Because different countries take different approaches to ensuring occupational safety and health, areas of OSH need and focus also vary between countries and regions. Similar to the findings of the ENHSPO survey conducted in Australia, the Institute of Occupational Medicine found that in the UK, there is a need to put a greater emphasis on work-related illness. In contrast, in Australia and the USA a major responsibility of the OHS professional is to keep company directors and managers aware of the issues that they face in regards to Occupational Health and Safety principles and legislation. However, in some other areas of Europe, it is precisely this which has been lacking: "Nearly half of senior managers and company directors do not have an up-to-date understanding of their health and safety-related duties and responsibilities."

Identifying safety and health hazards

Hazards, risks, outcomes

The terminology used in OSH varies between countries, but generally speaking:

- A hazard is something that can cause harm if not controlled.
- The outcome is the harm that results from an uncontrolled hazard.
- A risk is a combination of the probability that a particular outcome will occur and the severity of the harm involved.

"Hazard", "risk", and "outcome" are used in other fields to describe e.g. environmental damage, or damage to equipment. However, in the context of OSH, "harm" generally describes the direct or indirect degradation, temporary or permanent, of the physical, mental, or social well-being of workers. For example, repetitively carrying out manual handling of heavy objects is a hazard. The outcome could be a musculoskeletal disorder (MSD) or an acute back or joint injury. The risk can be expressed numerically (e.g. a 0.5 or 50/50 chance of the outcome occurring during a year), in relative terms (e.g. "high/medium/low"), or with a multi-dimensional classification scheme (e.g. situation-specific risks.

Hazard assessment

Hazard analysis or hazard assessment is a process in which individual hazards of the workplace are identified, assessed and controlled/eliminated as close to source (location of the hazard) as reasonable and possible. As technology, resources, social expectation or regulatory requirements

change, hazard analysis focuses controls more closely toward the source of the hazard. Thus hazard control is a dynamic program of prevention. Hazard-based programs also have the advantage of not assigning or implying there are "acceptable risks" in the workplace. A hazard-based program may not be able to eliminate all risks, but neither does it accept "satisfactory" – but still risky – outcomes. And as those who calculate and manage the risk are usually managers while those exposed to the risks are a different group, workers, a hazard-based approach can by-pass conflict inherent in a risk-based approach.

Risk assessment

Modern occupational safety and health legislation usually demands that a risk assessment be carried out prior to making an intervention. It should be kept in mind that risk management requires risk to be managed to a level which is as low as is reasonably practical.

This assessment should:

- Identify the hazards
- Identify all affected by the hazard and how
- Evaluate the risk
- Identify and prioritize appropriate control measures

The calculation of risk is based on the likelihood or probability of the harm being realized and the severity of the consequences. This can be expressed mathematically as a quantitative assessment (by assigning low, medium and high likelihood and severity with integers and multiplying them to obtain a risk factor), or qualitatively as a description of the circumstances by which the harm could arise.

The assessment should be recorded and reviewed periodically and whenever there is a significant change to work practices. The assessment should include practical recommendations to control the risk. Once recommended controls are implemented, the risk should be re-calculated to determine of it has been lowered to an acceptable level. Generally speaking, newly introduced controls should lower risk by one level, i.e., from high to medium or from medium to low.

Contemporary developments

On an international scale, the World Health Organization (WHO) and the International Labour Organization (ILO) have begun focusing on labour environments in developing nations with

projects such as Healthy Cities. Many of these developing countries are stuck in a situation in which their relative lack of resources to invest in OSH leads to increased costs due to work-related illnesses and accidents. As a 2007 Factsheet from the European Agency for Safety and Health at Work states: "Countries with less developed OSH systems spend a far higher percentage of GDP on work-related injury and illness – taking resources away from more productive activities . . . The ILO estimates that work-related illness and accidents cost up to 10% of GDP in Latin America, compared with just 2.6% to 3.8% in the EU."

Nanotechnology

A nanomaterial containment hood, an example of an engineering control used to protect workers handling them on a regular basis.

Nanotechnology is an example of a new, relatively unstudied technology. A Swiss survey of one hundred thirty eight companies using or producing nanoparticulate matter in 2006, resulted in forty completed questionnaires. Sixty five per cent of respondent companies stated they did not have a formal risk assessment process for dealing with nanoparticulate matter. Nanotechnology already presents new issues for OSH professionals that will only become more difficult as nanostructures become more complex. The size of the particles renders most containment and personal protective equipment ineffective. The toxicology values for macro sized industrial substances are rendered inaccurate due to the unique nature of nanoparticulate matter. As nanoparticulate matter decreases in size its relative surface area increases dramatically, increasing any catalytic effect or chemical reactivity substantially versus the known value for the macro substance. This presents a new set of challenges in the near future to rethink contemporary

measures to safeguard the health and welfare of employees against a nanoparticulate substance that most conventional controls have not been designed to manage.

Relationship to industrial and organizational psychology

Industrial and organizational psychology is a discipline within psychology, which also covers the psychological aspects of occupational health and wellbeing, occupational stress, work organization and psychosocial factors and occupational safety and health.

Occupational health psychology

Occupational health psychology (OHP) is a relatively new field that combines elements of occupational health and safety, industrial/organizational psychology, and health psychology. The field is concerned with identifying work-related psychosocial factors that adversely affect the health of people who work. OHP is also concerned with developing ways to effect change in workplaces for the purpose of improving the health of people who work. For more detail on OHP, see the section on occupational health psychology.

Occupational health and safety education

There are multiple levels of training applicable to the field of Occupational Health and Safety (OSH). Programs range from individual non-credit certificates, focusing on specific areas of concern, to full doctoral programs. The University of Southern California was one of the first schools in the nation to offer a Ph.D. program focusing on the field. Further, multiple masters degree programs exist, such as that of the Indiana State University who offer a master of science (MS) and a master of arts (MA) in OSH. Graduate programs are designed to train educators, as well as, high-level practitioners. Many OSH generalists focus on undergraduate studies; programs within schools, such as that of the University of North Carolina's online Bachelor of Science in Environmental Health and Safety, fill a large majority of hygienist needs. However, smaller companies often don’t have full-time safety specialists on staff, thus, they appoint a current employee to the responsibility. Individuals finding themselves in positions such as these, or for those enhancing marketability in the job-search and promotion arena, may seek out a credit certificate program. For example, the University of Connecticut's online OSH Certificate, provides students familiarity with overarching concepts through a 15-credit (5-course) program.

Programs such as these are often adequate tools in building a strong educational platform for new safety managers with a minimal outlay of time and money. Further, most hygienists seek certification by organizations which train in specific areas of concentration, focusing on isolated workplace hazards. The American Society for Safety Engineers (ASSE),American Board of Industrial Hygiene (ABIH), and American Industrial Hygiene Association (AIHA) offer individual certificates on many different subjects from forklift operation to waste disposal and are the chief facilitators of continuing education in the OSH sector.

World Day for Safety and Health at Work

On April 28 The International Labour Organisation celebrates "World Day for Safety and Health" to raise awareness of safety in the workplace. Occurring annually since 2003, each year it focuses on a specific area and bases a campaign around the theme.

Chapter 5
Hygiene

Hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases. Medical hygiene therefore includes a specific set of practices associated with this preservation of health, for example environmental cleaning, sterilization of equipment, hand hygiene, water and sanitation and safe disposal of medical waste.

Hygiene is a set of practices performed for the preservation of health. While in modern medical sciences there is a set of standards of hygiene recommended for different situations, what is considered hygienic or not can vary between different cultures, genders and etarian groups. Some regular hygienic practices may be considered good habits by a society while the neglect of hygiene can be considered disgusting, disrespectful or even threatening.
Sanitation involves the hygienic disposal and treatment by the civic authority of potentially unhealthy human waste, such as sewerage and drainage.

Etymology

First attested in English in 1677s, the word hygiene comes from the French hygiène, the latinisation of theGreek ὑγιεινή (τέχνη) - hugieinē technē, meaning "(art) of health", from ὑγιεινός (hugieinos), "good for the health, healthy", in turn from ὑγιής (hugiēs), "healthful, sound, salutary, wholesome". In ancient Greek religion, Hygeia (Ὑγίεια) was the personification of health.

Concept of hygiene

Hygiene is an old concept related to medicine, as well as to personal and professional care practices related to most aspects of living. In medicine and in home (domestic) and everyday life settings, hygiene practices are employed as preventative measures to reduce the incidence and spreading of disease. In the manufacture of food, pharmaceutical, cosmetic and other products, good hygiene is a key part of quality assurance i.e. ensuring that the product complies with microbial specifications appropriate to its use. The terms cleanliness (or cleaning) and hygiene

are often used interchangeably, which can cause confusion. In general, hygiene mostly means practices that prevent spread of disease-causing organisms. Since cleaning processes (e.g., hand washing) remove infectious microbes as well as dirt and soil, they are often the means to achieve hygiene. Other uses of the term appear in phrases including: body hygiene, personal hygiene, sleep hygiene, mental hygiene, dental hygiene, and occupational hygiene, used in connection with public health. Hygiene is also the name of a branch of science that deals with the promotion and preservation of health, also called hygienic. Hygiene practices vary widely, and what is considered acceptable in one culture might not be acceptable in another.

Medical hygiene

Medical hygiene pertains to the hygiene practices related to the administration of medicine, and medical care, that prevents or minimizes disease and the spreading of disease.

Medical hygiene practices include:

- Isolation or quarantine of infectious persons or materials to prevent spread of infection.
- Sterilization of instruments used in surgical procedures.
- Use of protective clothing and barriers, such as masks, gowns, caps, eyewear and gloves.
- Proper bandaging and dressing of injuries.
- Safe disposal of medical waste.
- Disinfection of reusables (i.e. linen, pads, uniforms)
- Scrubbing up, hand-washing, especially in an operating room, but in more general health-care settings as well, where diseases can be transmitted

Most of these practices were developed in the 19th century and were well established by the mid-20th century. Some procedures (such as disposal of medical waste) were refined in response to late-20th century disease outbreaks, notably AIDS and Ebola.

Home and everyday life hygiene

Home hygiene pertains to the hygiene practices that prevent or minimize disease and the spreading of disease in home (domestic) and in everyday life settings such as social settings, public transport, the work place, public places etc.

Hygiene in home and everyday life settings plays an important part in preventing spread of infectious diseases. It includes procedures used in a variety of domestic situations such as hand hygiene, respiratory hygiene, food and water hygiene, general home hygiene(hygiene of

environmental sites and surfaces), care of domestic animals, and home healthcare (the care of those who are at greater risk of infection).

At present, these components of hygiene tend to be regarded as separate issues, although all are based on the same underlying microbiological principles. Preventing the spread of infectious diseases means breaking the chain of infection transmission. The simple principle is that, if the chain of infection is broken, infection cannot spread. In response to the need for effective codes of hygiene in home and everyday life settings the International Scientific Forum on Home Hygiene has developed a risk-based approach (based on Hazard Analysis Critical Control Point (HACCP), which has come to be known as "targeted hygiene". Targeted hygiene is based on identifying the routes of spread of pathogens in the home, and applying hygiene procedures at critical points at appropriate times to break the chain of infection.

The main sources of infection in the home are people (who are carriers or are infected), foods (particularly raw foods) and water, and domestic animals (in western countries more than 50% of homes have one or more pets). Additionally, sites that accumulate stagnant water—such as sinks, toilets, waste pipes, cleaning tools, face cloths—readily support microbial growth, and can become secondary reservoirs of infection, though species are mostly those that threaten "at risk" groups. Germs (potentially infectious bacteria, viruses etc.) are constantly shed from these sources via mucous membranes, faeces, vomit, skin scales, etc. Thus, when circumstances combine, people become exposed, either directly or via food or water, and can develop an infection. The main "highways" for spread of germs in the home are the hands, hand and food contact surfaces, and cleaning cloths and utensils. Germs can also spread via clothing and household linens such as towels. Utilities such as toilets and wash basins, for example, were invented for dealing safely with human waste, but still have risks associated with them, which may become critical at certain times, e.g., when someone has sickness or diarrhea. Safe disposal of human waste is a fundamental need; poor sanitation is a primary cause of diarrheal disease in low income communities. Respiratory viruses and fungal spores are also spread via the air.

Good home hygiene means targeting hygiene procedures at critical points, at appropriate times, to break the chain of infection i.e. to eliminate germs before they can spread further. Because the "infectious dose" for some pathogens can be very small (10-100 viable units, or even less for some viruses), and infection can result from direct transfer from surfaces via hands or food to the

mouth, nasal mucosa or the eye, 'hygienic cleaning' procedures should be sufficient to eliminate pathogens from critical surfaces. Hygienic cleaning can be done by:

- Mechanical removal (i.e. cleaning) using a soap or detergent. To be effective as a hygiene measure, this process must be followed by thorough rinsing under running water to remove germs from the surface.
- Using a process or product that inactivates the pathogens in situ. Germ kill is achieved using a "micro-biocidal" product i.e. a disinfectant or antibacterial product or waterless hand sanitizer, or by application of heat.
- In some cases combined germ removal with kill is used, e.g. laundering of clothing and household linens such as towels and bedlinen.

Some hygiene accessories.

Hand hygiene

Hand hygiene is defined as hand washing or washing hands and nails with soap and water or using a waterless hand sanitizer.

Hand hygiene is central to preventing spread of infectious diseases in home and everyday life settings.

In situations where hand washing with soap is not an option (e.g. when in a public place with no access to wash facilities), a waterless hand sanitizer such as an alcohol hand gel can be used. They can also be used in addition to hand washing, to minimize risks when caring for "at risk" groups. To be effective, alcohol hand gels should contain not less than 60%v/v alcohol. Hand sanitizers are not an option in most developing countries; in situations where availability of water is a problem, there are appropriate solutions such as tippy-taps which use much less water and are cheap to make. In low income communities, mud or ash is sometimes used as an alternative to soap.

Respiratory hygiene

Correct respiratory and hand hygiene when coughing and sneezing reduces the spread of germs particularly during the cold and flu season.

- Carry tissues and use them to catch coughs and sneezes
- Dispose of tissues as soon as possible
- Clean your hands by hand washing or using an alcohol hand sanitizer.

Food hygiene at home

Food hygiene is concerned with the hygiene practices that prevent food poisoning. The five key principles of food hygiene, according to WHO, are:

1. Prevent contaminating food with pathogens spreading from people, pets, and pests.
2. Separate raw and cooked foods to prevent contaminating the cooked foods.
3. Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
4. Store food at the proper temperature.
5. Use safe water and raw materials

Household water treatment and safe storage

Household water treatment and safe storage ensure drinking water is safe for consumption. Drinking water quality remains a significant problem, not only in developing countrie but also in developed countries; even in the European region it is estimated that 120 million people do not have access to safe drinking water. Point-of-use water quality interventions can reduce diarrheal disease in communities where water quality is poor, or in emergency situations where there is a breakdown in water supply. Since water can become contaminated during storage at home (e.g. by contact with contaminated hands or using dirty storage vessels), safe storage of water in the home is also important.

Methods for treatment of drinking water, include:

1. Chemical disinfection using chlorine or iodine
2. Boiling
3. Filtration using ceramic filters

4. Solar disinfection - Solar disinfection is an effective method, especially when no chemical disinfectants are available.
5. UV irradiation - community or household UV systems may be batch or flow-though. The lamps can be suspended above the water channel or submerged in the water flow.
6. Combined flocculation/disinfection systems – available as sachets of powder that act by coagulating and flocculating sediments in water followed by release of chlorine.
7. Multibarrier methods – Some systems use two or more of the above treatments in combination or in succession to optimize efficacy.

Hygiene in the kitchen, bathroom and toilet

Routine cleaning of "contact" (hand, food and drinking water) sites and surfaces (such as toilet seats and flush handles, door and tap handles, work surfaces, bath and basin surfaces) in the kitchen, bathroom and toilet reduces the risk of spread of germs. The infection risk from the toilet itself is not high, provided it is properly maintained, although some splashing and aerosol formation can occur during flushing, particularly where someone in the family has diarrhea. Germs can survive in the scum or scale left behind on baths and wash basins after washing and bathing.

Water left stagnant in the pipes of showers can be contaminated with germs that become airborne when the shower is turned on. If a shower has not been used for some time, it should be left to run at a hot temperature for a few minutes before use.

Thorough cleaning is important in preventing the spread of fungal infections. Molds can live on wall and floor tiles and on shower curtains. Mold can be responsible for infections, cause allergic responses, deteriorate/damage surfaces and cause unpleasant odors. Primary sites of fungal growth are inanimate surfaces, including carpets and soft furnishings. Air-borne fungi are usually associated with damp conditions, poor ventilation or closed air systems.

Cleaning of toilets and hand wash facilities is important to prevent odors and make them socially acceptable. Social acceptance is an important part of encouraging people to use toilets and wash their hands.

Laundry hygiene

Laundry hygiene pertains to the practices that prevent or minimize disease and the spreading of disease via soiled clothing and household linens such as towels. Items most likely to be

contaminated with pathogens are those that come into direct contact with the body, e.g., underwear, personal towels, facecloths, nappies. Cloths or other fabric items used during food preparation, or for cleaning the toilet or cleaning up material such as faeces or vomit are a particular risk.

Microbiological and epidemiological data indicates that clothing and household linens etc are a risk factor for infection transmission in home and everyday life settings as well as institutional settings, although the lack of quantitative data directly linking contaminated clothing to infection in the domestic setting makes it difficult to assess the extent of the risk. Although microbiological data indicates that risks from clothing and household linens are somewhat less than those associated with hands, hand contact and food contact surfaces, and cleaning cloths, nevertheless these risks needs to be appropriately managed through effective laundering practices. In the home, this routine should be carried out as part of a multibarrier approach to hygiene which also includes hand, food, respiratory and other hygiene practices.

Infection risks from contaminated clothing etc can increase significantly under certain conditions. e.g. in healthcare situations in hospitals, care homes and the domestic setting where someone has diarrhoea, vomiting, or a skin or wound infection. It also increases in circumstances where someone has reduced immunity to infection.

Hygiene measures, including laundry hygiene, are an important part of reducing spread of antibiotic resistant strains. In the community, otherwise healthy people can become persistent skin carriers of MRSA, or faecal carriers of enterobacteria strains which can carry multi-antibiotic resistance factors (e.g. NDM-1 or ESBL-producing strains). The risks are not apparent until, for example, they are admitted to hospital, when they can become “self infected” with their own resistant organisms following a surgical procedure. As persistent nasal, skin or bowel carriage in the healthy population spreads “silently” across the world, the risks from resistant strains in both hospitals and the community increases. In particular the data indicates that clothing and household linens are a risk factor for spread of S. aureus (including MRSA and PVL-producing MRSA strains), and that effectiveness of laundry processes may be an important factor in defining the rate of community spread of these strains. Experience in the USA suggests that these strains are transmissible within families, but also in community settings such as prisons, schools and sport teams. Skin-to-skin contact (including unabraded skin) and indirect

contact with contaminated objects such as towels, sheets and sports equipment seem to represent the mode of transmission.

During laundering, temperature, together with the action of water and detergent work together to reduce microbial contamination levels on fabrics. During the wash cycle soil and microbes are detached from fabrics and suspended into the wash water. These are then "washed away" during the rinse and spin cycles. In addition to physical removal, micro-organisms can be killed by thermal inactivation which increases as the temperature is increased. Chemical inactivation of microbes by the surfactants and activated oxygen-based bleach used in detergents also contributes to the hygiene effectiveness of laundering. Adding hypochlorite bleach in the washing process also achieves inactivation of microbes. A number of other factors can also contribute including drying and ironing.

Laundry detergents contain a mix of ingredients including surfactants, builders, optical brighteners, etc. Cleaning action arises primarily from the action of the surfactants and other ingredients, which are designed to maximise release and suspension of dirt and microbes into the wash liquid, together with enzymes and/or an activated oxygen-based bleach which digest and remove stains. Although activated oxygen bleach is included in many powder detergents to digest and remove stains, it also produces some chemical inactivation of bacteria, fungi and viruses. As a rule of thumb, powders and tablets normally contain an activated oxygen bleach, but liquids, and all products (liquid or powder) used for "coloureds" do not. Surfactants also exert some chemical inactivation action against certain species although the extent of their action is not known.

In 2013 the International Scientific Forum on Home Hygiene (IFH) reviewed some 30 studies of the hygiene effectiveness of laundering at various temperatures ranging from room temperature to 70°C, under varying conditions. A key finding was the lack of standardisation and control within studies, and the variability in test conditions between studies such as wash cycle time, number of rinses etc. The consequent variability in the data (i.e the reduction in contamination on fabrics) obtained, in turn makes it extremely difficult to propose guidelines for laundering with any confidence, based on currently available data. As a result there is significant variability in the recommendations for hygienic laundering of clothing etc given by different agencies. Of concern is recent data suggesting that, in reality, modern domestic washing machines do not reach the temperature specified on the machine controls.

Medical hygiene at home

Medical hygiene pertains to the hygiene practices that prevents or minimizes disease and the spreading of disease in relation to administering medical care to those who are infected or who are more "at risk" of infection in the home. Across the world, governments are increasingly under pressure to fund the level of healthcare that people expect. Care of increasing numbers of patients in the community, including at home is one answer, but can be fatally undermined by inadequate infection control in the home. Increasingly, all of these "at-risk" groups are cared for at home by a carer who may be a household member who thus requires a good knowledge of hygiene. People with reduced immunity to infection, who are looked after at home, make up an increasing proportion of the population (currently up to 20%). The largest proportion are the elderly who have co-morbidities, which reduce their immunity to infection. It also includes the very young, patients discharged from hospital, taking immune-suppressive drugs or using invasive systems, etc. For patients discharged from hospital, or being treated at home special "medical hygiene" (see above) procedures may need to be performed for them e.g. catheter or dressing replacement, which puts them at higher risk of infection.

Antiseptics may be applied to cuts, wounds abrasions of the skin to prevent the entry of harmful bacteria that can cause sepsis. Day-to-day hygiene practices, other than special medical hygiene procedures are no different for those at increased risk of infection than for other family members. The difference is that, if hygiene practices are not correctly carried out, the risk of infection is much greater.

Home hygiene in low-income communities

In the developing world, for decades, universal access to water and sanitation has been seen as the essential step in reducing the preventable ID burden, but it is now clear that this is best achieved by programs that integrate hygiene promotion with improvements in water quality and availability, and sanitation. About 2 million people die every year due to diarrheal diseases, most of them are children less than 5 years of age. The most affected are the populations in developing countries, living in extreme conditions of poverty, normally peri-urban dwellers or rural inhabitants. Providing access to sufficient quantities of safe water, the provision of facilities for a sanitary disposal of excreta, and introducing sound hygiene behaviors are of capital importance to reduce the burden of disease caused by these risk factors.

Research shows that, if widely practiced, hand washing with soap could reduce diarrhea by almost fifty percent and respiratory infections by nearly twenty-five percent Hand washing with soap also reduces the incidence of skin diseases, eye infections like trachoma and intestinal worms, especially ascariasis and trichuriasis.

Other hygiene practices, such as safe disposal of waste, surface hygiene, and care of domestic animals, are also important in low income communities to break the chain of infection transmission.

Disinfectants and antibacterials in home hygiene

Chemical disinfectants are products that kill germs (harmful bacteria, viruses and fungi). If the product is a disinfectant, the label on the product should say "disinfectant" and/or "kills" germs or bacteria etc. Some commercial products, e.g. bleaches, even though they are technically disinfectants, say that they "kill germs", but are not actually labelled as "disinfectants". Not all disinfectants kill all types of germs. All disinfectants kill bacteria (called bactericidal). Some also kill fungi (fungicidal), bacterial spores (sporicidal) and/or viruses (virucidal).

An antibacterial product is a product that acts against bacteria in some unspecified way. Some products labelled "antibacterial" kill bacteria while others may contain a concentration of active ingredient that only prevent them multiplying. It is, therefore, important to check whether the product label states that it "kills" bacteria." An antibacterial is not necessarily anti-fungal or anti-viral unless this is stated on the label.

The term sanitizer has been used to define substances that both clean and disinfect. More recently this term has been applied to alcohol-based products that disinfect the hands (alcohol hand sanitizers). Alcohol hand sanitizers however are not considered to be effective on soiled hands.

The term biocide is a broad term for a substance that kills, inactivates or otherwise controls living organisms. It includes antiseptics and disinfectants, which combat micro-organisms, and also includes pesticides.

Chapter 6
Personal Hygiene

Personal hygiene involves those practices performed by an individual to care for one's bodily health and well being, through cleanliness. Motivations for personal hygiene practice include reduction of personal illness, healing from personal illness, optimal health and sense of well being, social acceptance and prevention of spread of illness to others. What is considered proper personal hygiene can be cultural-specific and may change over time. In some cultures removal of body hair is considered proper hygiene. Other practices that are generally considered proper hygiene include bathing regularly, washing hands regularly and especially before handling food, washing scalp hair, keeping hair short or removing hair, wearing underwear, wearing clean clothing, brushing one's teeth, cutting finger nails, besides other practices. Some practices are gender-specific, such as by a woman during her menstrual cycle. People tend to develop a routine for attending to their personal hygiene needs. Other personal hygienic practices would include covering one's mouth when coughing, disposal of soiled tissues appropriately, making sure toilets are clean, and making sure food handling areas are clean, besides other practices. Some cultures do not kiss or shake hands to reduce transmission of bacteria by contact.

Personal grooming extends personal hygiene as it pertains to the maintenance of a good personal and public appearance, which need not necessarily be hygienic. It may involve, for example, using deodorants or perfume, shaving, or combing, besides other practices.

Excessive body hygiene

The benefits of body hygiene can be diminished by the risks of excessive body hygiene, which is hypothesized to cause allergic disease and bodily irritation.

Excessive body hygiene and allergies

The hygiene hypothesis was first formulated in 1989 by Strachan who observed that there was an inverse relationship between family size and development of atopic allergic disorders – the more children in a family, the less likely they were to develop these allergies. From this, he hypothesised that lack of exposure to "infections" in early childhood transmitted by contact with older siblings could be a cause of the rapid rise in atopic disorders over the last thirty to forty

years. Strachan further proposed that the reason why this exposure no longer occurs is, not only because of the trend towards smaller families, but also "improved household amenities and higher standards of personal cleanliness".

Although there is substantial evidence that some microbial exposures in early childhood can in some way protect against allergies, there is no evidence that we need exposure to harmful microbes (infection) or that we need to suffer a clinical infection. Nor is there evidence that hygiene measures such as hand washing, food hygiene etc. are linked to increased susceptibility to atopic disease. If this is the case, there is no conflict between the goals of preventing infection and minimising allergies. A consensus is now developing among experts that the answer lies in more fundamental changes in lifestyle etc. that have led to decreased exposure to certain microbial or other species, such as helminths, that are important for development of immuno-regulatory mechanisms. There is still much uncertainty as to which lifestyle factors are involved.

Although media coverage of the hygiene hypothesis has declined, a strong ‘collective mindset’ has become established that dirt is ‘healthy’ and hygiene somehow ‘unnatural’. This has caused concern among health professionals that everyday life hygiene behaviours, which are the foundation of public health, are being undermined. In response to the need for effective hygiene in home and everyday life settings, the International Scientific Forum on Home Hygiene has developed a "risk-based" or targeted approach to home hygiene that seeks to ensure that hygiene measures are focussed on the places, and at the times most critical for infection transmission. Whilst targeted hygiene was originally developed as an effective approach to hygiene practice, it also seeks, as far as possible, to sustain "normal" levels of exposure to the microbial flora of our environment to the extent that is important to build a balanced immune system.

Excessive body hygiene of external ear canals

Excessive body hygiene of the ear canals can result in infection or irritation. The ear canals require less body hygiene care than other parts of the body, because they are sensitive, and the body system adequately cares for these parts. Most of the time the ear canals are self-cleaning; that is, there is a slow and orderly migration of the skin lining the ear canal from the eardrum to the outer opening of the ear. Old earwax is constantly being transported from the deeper areas of the ear canal out to the opening where it usually dries, flakes, and falls out. Attempts to clean the ear canals through the removal of earwax can actually reduce ear canal cleanliness by pushing

debris and foreign material into the ear that the natural movement of ear wax out of the ear would have removed.

Excessive body hygiene of skin

Excessive body hygiene of the skin can result in skin irritation. The skin has a natural layer of oil, which promotes elasticity, and protects the skin from drying. When washing, unless using aqueous creams with compensatory mechanisms, this layer is removed leaving the skin unprotected.

Excessive application of soaps, creams, and ointments can also adversely affect certain of the natural processes of the skin. For examples, soaps and ointments can deplete the skin of natural protective oils and fat-soluble content such as cholecalciferol (vitamin D3), and external substances can be absorbed, to disturb natural hormonal balances.

Culinary (food) hygiene

Culinary hygiene pertains to the practices related to food management and cooking to prevent food contamination, prevent food poisoning and minimize the transmission of disease to other foods, humans or animals. Culinary hygiene practices specify safe ways to handle, store, prepare, serve and eat food.

Culinary practices include:

- Cleaning and disinfection of food-preparation areas and equipment (for example using designated cutting boards for preparing raw meats and vegetables). Cleaning may involve use of chlorine bleach, ethanol, ultraviolet light, etc. for disinfection.
- Careful avoidance of meats contaminated by trichina worms, salmonella, and other pathogens; or thorough cooking of questionable meats.
- Extreme care in preparing raw foods, such as sushi and sashimi.
- Institutional dish sanitizing by washing with soap and clean water.
- Washing of hands thoroughly before touching any food.
- Washing of hands after touching uncooked food when preparing meals.
- Not using the same utensils to prepare different foods.
- Not sharing cutlery when eating.
- Not licking fingers or hands while or after eating.

- Not reusing serving utensils that have been licked.
- Proper storage of food so as to prevent contamination by vermin.
- Refrigeration of foods (and avoidance of specific foods in environments where refrigeration is or was not feasible).
- Labeling food to indicate when it was produced (or, as food manufacturers prefer, to indicate its "best before" date).
- Proper disposal of uneaten food and packaging.

Personal service hygiene

Personal service hygiene pertains to the practices related to the care and use of instruments used in the administration of personal care services to people:

Personal hygiene practices include:

- Sterilization of instruments used by service providers including hairdressers, aestheticians, and other service providers.
- Sterilization by autoclave of instruments used in body piercing and tattoo marking.
- Cleaning hands.

History of hygienic practices

The earliest written account of Elaborate codes of hygiene can be found in several Hindu texts, such as the Manusmriti and the Vishnu Purana. Bathing is one of the five Nitya karmas (daily duties) in Hinduism, and not performing it leads to sin, according to some scriptures.

Three young women bathing, 440–430 BC. Ancient Greece.

Regular bathing was a hallmark of Roman civilization. Elaborate baths were constructed in urban areas to serve the public, who typically demanded the infrastructure to maintain personal cleanliness. The complexes usually consisted of large, swimming pool-like baths, smaller cold and hot pools, saunas, and spa-like facilities where individuals could be depilated, oiled, and massaged. Water was constantly changed by an aqueduct-fed flow. Bathing outside of urban centers involved smaller, less elaborate bathing facilities, or simply the use of clean bodies of water. Roman cities also had large sewers, such as Rome's Cloaca Maxima, into which public and private latrines drained. Romans didn't have demand-flush toilets but did have some toilets with a continuous flow of water under them. (Similar toilets are seen in Acre Prison in the film Exodus.)

Until the late 19th Century, only the elite in Western cities typically possessed indoor facilities for relieving bodily functions. The poorer majority used communal facilities built above cesspools in backyards and courtyards. This changed after Dr. John Snow discovered that cholera was transmitted by the fecal contamination of water. Though it took decades for his findings to gain wide acceptance, governments and sanitary reformers were eventually convinced of the health benefits of using sewers to keep human waste from contaminating water. This encouraged the widespread adoption of both the flush toilet and the moral imperative that bathrooms should be indoors and as private as possible.

Islamic hygienical jurisprudence

Since the 7th century, Islam has always placed a strong emphasis on hygiene. Other than the need to be ritually clean in time for the daily prayer (Arabic: Salat) through Wudu and Ghusl, there are a large number of other hygiene-related rules governing the lives of Muslims. Other issues include the Islamic dietary laws. In general, the Qur'an advises Muslims to uphold high standards of physical hygiene and to be ritually clean whenever possible.

Hygiene in medieval Europe

Contrary to popular belief and although the Early Christian leaders condemned bathing as unspiritual, bathing and sanitation were not lost in Europe with the collapse of the Roman Empire. Soapmaking first became an established trade during the so-called "Dark Ages". The Romans usedscented oils (mostly from Egypt), among other alternatives.

Northern Europeans were not in the habit of bathing: in the ninth century Notker the Stammerer, a Frankish monk of St Gall, related a disapproving anecdote that attributed ill results of personal hygiene to an Italian fashion:

There was a certain deacon who followed the habits of the Italians in that he was perpetually trying to resist nature. He used to take baths, he had his head very closely shaved, he polished his skin, he cleaned his nail, he had his hair cut as short as if it were turned on a lathe, and he wore linen underclothes and a snow-white shirt.

Woman's Bath, 1496, by Albrecht Dürer

Secular medieval texts constantly refer to the washing of hands before and after meals, but Sone de Nansay, hero of a 13th-century romance, discovers to his chagrin that the Norwegians do not wash up after eating. In the 11th and 12th centuries, bathing was essential to the Western European upper class: the Cluniac monasteries to which they resorted or retired were always provided with bathhouses, and even the monks were required to take full immersion baths twice a year, at the two Christian festivals of renewal, though exhorted not to uncover themselves from under their bathing sheets. In 14th century Tuscany, the newlywed couple's bath together was such a firm convention one such couple, in a large coopered tub, is illustrated in fresco in the town hall of San Gimignano.

Bathing had fallen out of fashion in Northern Europe long before the Renaissance, when the communal public baths of German cities were in their turn a wonder to Italian visitors. Bathing was replaced by the heavy use of sweat-bathing and perfume, as it was thought in Europe that water could carry disease into the body through the skin. Bathing encouraged an erotic atmosphere that was played upon by the writers of romances intended for the upper class; in the

tale of Melusine the bath was a crucial element of the plot. "Bathing and grooming were regarded with suspicion by moralists, however, because they unveiled the attractiveness of the body. Bathing was said to be a prelude to sin, and in the penitential of Burchard of Worms we find a full catalogue of the sins that ensued when men and women bathed together." Medieval church authorities believed that public bathing created an environment open to immorality and disease; the 26 public baths of Paris in the late 13th century were strictly overseen by the civil authorities. At a later date Roman Catholic Church officials even banned public bathing in an unsuccessful effort to halt syphilis epidemics from sweeping Europe.

Modern sanitation was not widely adopted until the 19th and 20th centuries. According to medieval historian Lynn Thorndike, people in Medieval Europe probably bathed more than people did in the 19th century. Some time after Louis Pasteur's experiments proved the germ theory of disease and Joseph Lister and others put them into practice in sanitation, hygienic practices came to be regarded as synonymous with health, as they are in modern times.

Industrial society

A social hygiene movement in the late 19th and early 20th centuries, sometimes including mental hygiene (now mental health), sexual hygiene and racial hygiene movements, was an attempt by Progressive-era reformers to prevent and control disease by changing the public's habits through the use of scientific research methods and modern media techniques. It was also based in part on eugenics, and by the 1930s thousands of forced sterilizations of people deemed undesirable took place in America each year. After 1945 when the Nazi's had taken it even further, the movement was largely discredited. The drive for cleanliness persisted, however, particularly cleanliness in children. This showed many benefits such as reduced child mortality rates. It also became increasingly commercialized, however, and may have contributed to environmental pollution, resistance to antibiotics, and even restricting the development of the immune system leading to increased incidence of diseases such as asthma or allergies.

An allergy is a hypersensitivity disorder of the immune system. Allergic reactions occur when a person's immune system reacts to normally harmless substances in the environment. A substance that causes a reaction is called an allergen. These reactions are acquired, predictable, and rapid. Allergy is one of four forms of hypersensitivity and is formally called type I (or immediate) hypersensitivity. Allergic reactions are distinctive because of excessive activation of certain

white blood cells called mast cells and basophils by a type of antibody called Immunoglobulin E (IgE). This reaction results in an inflammatory response which can range from uncomfortable to dangerous.

Mild allergies like hay fever are very common in the human population and cause symptoms such as red eyes, itchiness, and runny nose, eczema, hives, or an asthma attack. Allergies can play a major role in conditions such as asthma. In some people, severe allergies to environmental or dietary allergens or to medication may result in life-threatening reactions called anaphylaxis. Food allergies, and reactions to the venom of stinging insects such as wasps and bees are often associated with these severe reactions.

A variety of tests exist to diagnose allergic conditions. If done they should be ordered and interpreted in light of a person's history of exposure as many positive test results do not mean a clinically significant allergy. Tests include placing possible allergens on the skin and looking for a reaction such as swelling and blood tests to look for an allergen-specific IgE.

Treatments for allergies include avoiding known allergens, steroids that modify the immune system in general, and medications such as antihistamines and decongestants which reduce symptoms. Many of these medications are taken by mouth, although epinephrine, which is used to treat anaphylactic reactions, is injected. Immunotherapy uses injected allergens to desensitize the body's response.

Chapter 7

Food Hygiene & Kitchen Safety

It is necessary to always have someone with at least a current Elementary Food Hygiene Certificate overseeing the kitchen, other than when serving basic refreshments.

Guidelines are that:

• For other than serving refreshments, on each occasion when the kitchen is used there must be a team leader who takes responsibility for ensuring that these guidelines are followed.

• On entering the kitchen, place bags etc so that no one can trip over them

• If you are serving hot beverages, be careful carrying teapots or boiling water around the kitchen. Spillages must be mopped up immediately using the mop provided to avoid people slipping.

• COOKING & BAKING:

Before you start:

Personal care: Ensure nails are short, not varnished (chips of varnish can contaminate food, and colour hides dirt under nails), no nail extensions. Take off all jewellery (necklaces, WATCHES, brooches, all rings except plain bands) to prevent falling into food/bringing contaminants. Ensure no loose labels on clothes, etc, that might fall into food.

Then, put on an apron to protect the food from the contaminants on your clothes. Consider a hairnet (even though it looks a bit odd!) if you have long hair.

• **WASH** your hands in the hand-washing basin using liquid soap. Make sure you wash well between the fingers and scrub your nails. Remove stopper from sink before drying your hands - preferably with a paper towel.

1. Wet hands thoroughly
2. Use approved soap
3. Rub palms together
4. Rub the fingers
5. Rub the thumbs
6. Rinse hands thoroughly
7. Use paper towel for drying
8. Turn off the tap using the paper towel

• **DISINFECT** the work surfaces using the kitchen surface cleaner provided.

• **FOOD PREPARATION:** Chopping boards - choose the right one for the job - they are usually colour coded. Knives -choose a 'raw' or a 'cooked' knife to avoid contamination. Raw and cooked foods must be kept separate at all times - work in separate parts of the kitchen so as to have a P BACTERIA by properly handling, storing and preparing food.

There are many types of bacteria - two of the most common being salmonella and E-coli 0157. Bacteria are germs we all carry and they are a source of contamination. Bacteria on our skin, in our mouth, nose, ears, hair etc. Bacteria are also in the air, water, soil and on food.

Bacteria in can be killed by treatment –

- by HEAT (e.g. in cooking),
- CHEMICALS (e.g. in cleaning) or
- IRRADIATION (as used in the food processing industry).

Bacteria cause food poisoning and it is our job to prevent this. To prevent bacteria passing from us we should wear protective clothing e.g. a clean apron; a hairnet if hair is long.

The main HIGH RISK FOODS are :

1. All cooked meat and poultry.
2. Cooked meat products including gravy and stock.
3. Milk, cream, artificial cream, custards and dairy produce.
4. Cooked eggs and products made from eggs e.g. mayonnaise.
5. Shellfish and other seafood.
6. Cooked rice.

Bacteria multiply with

1. Warmth
2. Moisture
3. Food
4. Time

Bacteria can multiply every ten minutes and grow in the danger zone. The DANGER ZONE is between 5 o C and 63 o C. Therefore ONE bacterium becomes ONE THOUSAND in only 1 hour 40 minutes. Their preference for growth is 37 o C - blood heat. This is the most dangerous temperature.

• **TEMPERATURE**. To keep food in good condition high risk COLD FOOD should be kept below 5 o C and high risk HOT FOOD over 63 o C. Bacteria will not grow when frozen at -18 o C but are still there and will start to multiply when thawed out. If your organisation is designated to record the fridge/freezer temperature regularly, please do so when the fridge is first used.

• **FOOD POISONING**. The top 10 causes are:

1. Food prepared too far in advance and stored at room temperature, i.e. not refrigerated.
2. Cooling food too slowly prior to refrigeration.
3. Not re-heating food to high enough temperatures to destroy food poisoning bacteria.
4. The use of cooked food contaminated with food poisoning bacteria.
5. Undercooking
6. Not thawing frozen poultry for sufficient time
7. Cross-contamination from raw food to cooked food
8. Storing food below 63 o C
9. Infected food handlers
10. Use of left-overs – DON'T unless you know it is safe

Bacteria can be passed by:

1. Hands
2. Clothes and equipment
3. Hand contact surfaces
4. Food contact surfaces

Make sure the same utensils are not used for both raw and cooked food. They must be properly washed between the use of raw / cooked food.

• **ILLNESS**. Should you be unwell in any way (sickness, diarrhoea etc), do not prepare food on or for use at our premises. Ask someone else to cover for you. Any cuts should be completely covered with a plaster - preferably blue or green - which seals round the wound. Do not use strip dressings as germs can escape from the open ends.

• **CONTAMINATION** Food can be contaminated by :

1. People
2. Raw food

3. Insects

4. Rodents

5. Dust

6. Refuse, waste food

7. Animals, birds

If you should see any indication of insects, rodents, animals or birds in the church kitchen, notify staff immediately.

• COOKING and REHEATING FOOD

When food is cooked from fresh, the centre of the item must reach 75 o C. Re-heating food must be heated to a temperature in the centre of 82 o C. A probe thermometer is available in the kitchen for this purpose and you must check that reheated food reaches this temperature. The probe must be wiped with BACTERICIDAL disinfectant before and after use. Hot food must be served above 63 o C and can only be reheated once.

• KEEPING FOOD not for immediate use.

All food should be kept as cool as possible. Halls are well heated in winter for comfort but, for food, it can be a disaster. Keep high-risk food in the kitchen which is usually cooler than a hall. Also, food should be kept covered. This applies also to providing food available to snack on. Individual items which are not wrapped should be in covered

NUT ALLERGY can be very serious.

Avoid preparing/serving nuts or nutbased products where possible. Use strict disciplines to ensure no other

food is contaminated, and nut-based food is clearly labelled. containers and tongs/spoons MUST be used not fingers.

• FRIDGE

In the fridge, please keep raw and ready-to-eat food separate. Raw food should always be on the lowest shelf of the fridge. There will be a thermometer in the fridge and the temperature, when opened first thing in the morning, should not exceed 5 o C. If it exceeds this, please let staff know.

• CREAM and the like

We love it and so do the bugs, because of its high fat content. Cream should only be out of the fridge for 15 minutes. If homemade cream cakes are to be served, for instance, bring the pastry part, whip the cream in the kitchen and fill the cakes shortly before they will be eaten.

• LEFT OVER FOOD AND INGREDIENTS

Do not leave in the fridge in the hopes that others will use. Preferably take it home or dispose of it. It may seem wasteful, but it is safer. Out of date or opened cartons of anything can pose significant health risk. If you leave something for a while in the fridge (or freezer) to be collected later please bag it and put your name and the date on it.

Otherwise it may be thrown away by staff! If left for long it may still be binned!

• **WASHING HANDS :** Hands must be washed regularly and always in the following circumstances (following the procedure at the top):

1. When you visit the toilet
2. On entering the food room and before handling any food or equipment.
3. Between handling raw and cooked food.
4. After combing or touching your hair.
5. After eating, smoking, coughing or blowing your nose.
6. When you handle waste food or refuse.
7. When you handle cleaning chemicals.

• **CROCKERY & CUTLERY** When handling dishes etc

1. Do not handle any part which will be in touch with anyone's mouth.
2. Fingers should be outside cups. Use the handles when setting cups/mugs out.
3. Only handle cutlery by the handle.
4. Teaspoons in a dish should have the handles protruding to enable people to help themselves.
5. Disposable cups should be taken from the base of the tube to prevent your fingers going inside the cup.
6. Dishes which become cracked or chipped must be thrown out.

• WORK METHODICALLY, clear up as you go along.

• DRYING UP

Clean tea towels must be used or dishes left to air-dry (the latter is preferable to avoid cross contamination). Organisations should provide their own tea towels or, if using church ones, take them home, wash them and return to the church as soon as possible.

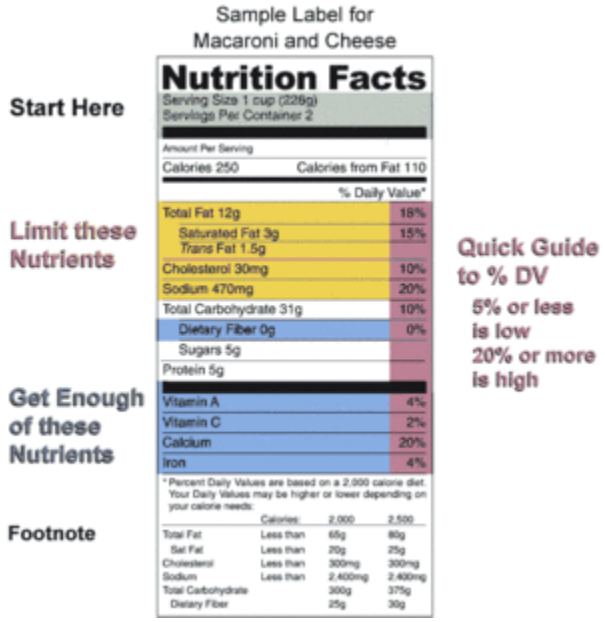
• **BEFORE LEAVING:** WORK SURFACES, sinks AND FLOORS must be disinfected after cooking with appropriate cleaners (bactericidal disinfectant for work surfaces, and a 'Cif' type of cleaner for the cooker top.

• **WASTE IN BINS:** If you have generated waste (and especially food waste that may begin to smell) it should be removed. Please compress the black bin liner (to reduce its volume) and knot it and remove it to an external bin or take home. Then replace with a clean bin liner from the kitchen drawer.

FINALLY, please remember we all BORROW the kitchen and need to leave it in a good and safe condition for others to use. preparation. They are trained to provide safe, evidence-based dietary advice and management to individuals (in health and disease), as well as to institutions. Clinical nutritionists are health professionals who focus more specifically on the role of nutrition in chronic disease, including possible prevention or remediation by addressing nutritional deficiencies before resorting to drugs. While government regulation of the use of this professional title is less universal than for "dietician", the field is supported by many high-level academic programs, up to and including the Doctoral level, and has

Chapter 8

Nutrients



The "Nutrition Facts" table indicates the amounts of nutrients which experts recommend to limit or consume in adequate amounts.

Nutrition is the process of breaking down food and substances taken in by the mouth to use for energy in the body. By practicing a healthy diet, many of the known health issues can be avoided.

The diet of an organism is what it eats, which is largely determined by the perceived palatability of foods. Dietitians are health professionals who specialize in human nutrition, meal planning, economics, and preparation. They are trained to provide safe, evidence-based dietary advice and management to individuals (in health and disease), as well as to institutions. Clinical nutritionists are health professionals who focus more specifically on the role of nutrition in chronic disease, including possible prevention or remediation by addressing nutritional deficiencies before resorting to drugs. While government regulation of the use of this professional title is less universal than for "dietician", the field is supported by many high-level academic programs, up to and including the Doctoral level, and has its own voluntary certification board, professional associations, and peer-reviewed journals, e.g. the American Society for Nutrition, Nutrition

Society of India, Food Scientists and Nutritionists Association India, Indian Dietetic Association and the American Journal of Clinical Nutrition.

A poor diet may have an injurious impact on health, causing deficiency diseases such as scurvy and kwashiorkor; health-threatening conditions like obesity and metabolic syndrome; and such common chronic systemic diseases as cardiovascular disease, diabetes, and osteoporosis.

Animal nutrition

Overview

Nutritional science investigates the metabolic and physiological responses of the body to diet. With advances in the fields of molecular biology, biochemistry, nutritional immunology, molecular medicine and genetics, the study of nutrition is increasingly concerned with metabolism and metabolic pathways: the sequences of biochemical steps through which substances in living things change from one form to another.

Carnivore and herbivore diets are contrasting, with basic nitrogen and carbon proportions being at varying levels in particular foods. Carnivores consume more nitrogen than carbon while herbivores consume less nitrogen than carbon, when an equal quantity is measured.

The human body contains chemical compounds, such as water, carbohydrates (sugar, starch, and fiber),amino acids (in proteins), fatty acids (in lipids), and nucleic acids (DNA and RNA). These compounds in turn consist of elements such as carbon, hydrogen, oxygen, nitrogen, phosphorus, calcium, iron, zinc,magnesium, manganese, and so on. All of these chemical compounds and elements occur in various forms and combinations (e.g. hormones, vitamins, phospholipids, hydroxyapatite), both in the human body and in the plant and animal organisms that humans eat.

The human body consists of elements and compounds ingested, digested, absorbed, and circulated through the bloodstream to feed the cells of the body. Except in the unborn fetus, the digestive system is the first system involved. In a typical adult, about seven liters of digestive juices enter the digestive tract. These digestive juices break chemical bonds in ingested molecules, and modify their conformations and energy states. Though some molecules are absorbed into the bloodstream unchanged, digestive processes release them from the matrix of foods. Unabsorbed matter, along with some waste products of metabolism, is eliminated from the body in the feces.

Studies of nutritional status must take into account the state of the body before and after experiments, as well as the chemical composition of the whole diet and of all material excreted and eliminated from the body (in urine and feces). Comparing the food to the waste can help determine the specific compounds and elements absorbed and metabolized in the body. The effects of nutrients may only be discernible over an extended period, during which all food and waste must be analyzed. The number of variables involved in such experiments is high, making nutritional studies time-consuming and expensive, which explains why the science of human nutrition is still slowly evolving.

In particular, the consumption of whole-plant foods slows digestion and allows better absorption, and a more favorable balance of essential nutrients per Calorie, resulting in better management of cell growth, maintenance, and mitosis (cell division), as well as better regulation of appetite and blood sugar. Regularly scheduled meals (every few hours) have also proven more wholesome than infrequent or haphazard ones, although a recent study has also linked more frequent meals with a higher risk of colon cancer in men.

Nutrients

There are six major classes of nutrients: carbohydrates, fats, minerals, protein, vitamins, and water.

These nutrient classes can be categorized as either macro-nutrients (needed in relatively large amounts) or micronutrients (needed in smaller quantities). The macronutrients include carbohydrates (including fiber), fats, protein, and water. The micronutrients are minerals and vitamins.

The macronutrients (excluding fiber and water) provide structural material (amino acids from which proteins are built, and lipids from which cell membranes and some signaling molecules are built) and energy. Some of the structural material can be used to generate energy internally, and in either case it is measured in Joules or kilocalories (often called "Calories" and written with a capital C to distinguish them from little 'c' calories). Carbohydrates and proteins provide 17 kJ approximately (4 kcal) of energy per gram, while fats provide 37 kJ (9 kcal) per gram., though the net energy from either depends on such factors as absorption and digestive effort, which vary substantially from instance to instance. Vitamins, minerals, fiber, and water do not provide energy, but are required for other reasons. A third class of dietary material, fiber (i.e.,

non-digestible material such as cellulose), is also required, for both mechanical and biochemical reasons, although the exact reasons remain unclear.

Molecules of carbohydrates and fats consist of carbon, hydrogen, and oxygen atoms. Carbohydrates range from simple monosaccharides (glucose, fructose, galactose) to complex polysaccharides (starch). Fats are triglycerides, made of assorted fatty acid monomers bound to a glycerol backbone. Some fatty acids, but not all, are essential in the diet: they cannot be synthesized in the body. Protein molecules contain nitrogen atoms in addition to carbon, oxygen, and hydrogen. The fundamental components of protein are nitrogen-containing amino acids, some of which are essential in the sense that humans cannot make them internally. Some of the amino acids are convertible (with the expenditure of energy) to glucose and can be used for energy production, just as ordinary glucose, in a process known as gluconeogenesis. By breaking down existing protein, the carbon skeleton of the various amino acids can be metabolized to intermediates in cellular respiration; the remaining ammonia is discarded primarily as urea in urine. This occurs normally only during prolonged starvation.

Other micronutrients include antioxidants and phytochemicals, which are said to influence (or protect) some body systems. Their necessity is not as well established as in the case of, for instance, vitamins.

Most foods contain a mix of some or all of the nutrient classes, together with other substances, such as toxins of various sorts. Some nutrients can be stored internally (e.g., the fat soluble vitamins), while others are required more or less continuously. Poor health can be caused by a lack of required nutrients or, in extreme cases, too much of a required nutrient. For example, both salt and water (both absolutely required) will cause illness or even death in excessive amounts.

Carbohydrates

Carbohydrates may be classified as monosaccharides, disaccharides, or polysaccharides depending on the number of monomer (sugar) units they contain. They constitute a large part of foods such as rice, noodles, bread, and other grain-based products. Monosaccharides, disaccharides, and polysaccharides contain one, two, and three or more sugar units, respectively. Polysaccharides are often referred to ascomplex carbohydrates because they are typically long, multiple branched chains of sugar units.

Traditionally, simple carbohydrates are believed to be absorbed quickly, and therefore to raise blood-glucose levels more rapidly than complex carbohydrates. This, however, is not accurate. Some simple carbohydrates (e.g. fructose) follow different metabolic pathways (e.g. fructolysis) which result in only a partial catabolism to glucose, while many complex carbohydrates may be digested at essentially the same rate as simple carbohydrates. Glucose stimulates the production of insulin through food entering the bloodstream, which is grasped by the beta cells in the pancreas.

Fiber

Dietary fiber is a carbohydrate that is incompletely absorbed in humans and in some animals. Like all carbohydrates, when it is metabolized it can produce four Calories (kilocalories) of energy per gram. However, in most circumstances it accounts for less than that because of its limited absorption and digestibility. Dietary fiber consists mainly of cellulose, a large carbohydrate polymer is indigestible as humans do not have the required enzymes to disassemble it. There are two subcategories: soluble and insoluble fiber. Whole grains, fruits (especially plums, prunes, and figs), and vegetables are good sources of dietary fiber. There are many health benefits of a high-fiber diet. Dietary fiber helps reduce the chance of gastrointestinal problems such as constipation and diarrhea by increasing the weight and size of stool and softening it. Insoluble fiber, found in whole wheat flour, nuts and vegetables, especially stimulates peristalsis– the rhythmic muscular contractions of the intestines which move digesta along the digestive tract. Soluble fiber, found in oats, peas, beans, and many fruits, dissolves in water in the intestinal tract to produce a gel which slows the movement of food through the intestines. This may help lower blood glucose levels because it can slow the absorption of sugar. Additionally, fiber, perhaps especially that from whole grains, is thought to possibly help lessen insulin spikes, and therefore reduce the risk of type 2 diabetes. The link between increased fiber consumption and a decreased risk of colorectal cancer is still uncertain.

Fat

A molecule of dietary fat typically consists of several fatty acids (containing long chains of carbon and hydrogen atoms), bonded to a glycerol. They are typically found as triglycerides (three fatty acids attached to one glycerol backbone). Fats may be classified as saturated or

unsaturated depending on the detailed structure of the fatty acids involved. Saturated fats have all of the carbon atoms in their fatty acid chains bonded to hydrogen atoms, whereas unsaturated fats have some of these carbon atoms double-bonded, so their molecules have relatively fewer hydrogen atoms than a saturated fatty acid of the same length. Unsaturated fats may be further classified as monounsaturated (one double-bond) or polyunsaturated (many double-bonds). Furthermore, depending on the location of the double-bond in the fatty acid chain, unsaturated fatty acids are classified as omega-3 or omega-6 fatty acids. Trans fats are a type of unsaturated fat with trans-isomer bonds; these are rare in nature and in foods from natural sources; they are typically created in an industrial process called (partial) hydrogenation. There are nine kilocalories in each gram of fat. Fatty acids such as conjugated linoleic acid, catalpic acid, eleostearic acid and punicic acid, in addition to providing energy, represent potent immune modulatory molecules.

Saturated fats (typically from animal sources) have been a staple in many world cultures for millennia. Unsaturated fats (e. g., vegetable oil) are considered healthier, while trans fats are to be avoided. Saturated and some trans fats are typically solid at room temperature (such as butter or lard), while unsaturated fats are typically liquids (such as olive oil or flaxseed oil). Trans fats are very rare in nature, and have been shown to be highly detrimental to human health, but have properties useful in the food processing industry, such as rancidity resistance.

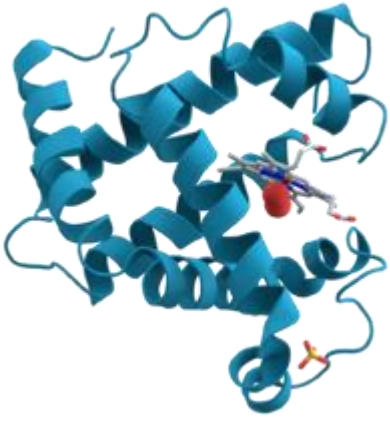
Essential fatty acids

Most fatty acids are non-essential, meaning the body can produce them as needed, generally from other fatty acids and always by expending energy to do so. However, in humans, at least two fatty acids areessential and must be included in the diet. An appropriate balance of essential fatty acids—omega-3 andomega-6 fatty acids—seems also important for health, although definitive experimental demonstration has been elusive. Both of these "omega" long-chain polyunsaturated fatty acids are substrates for a class ofeicosanoids known as prostaglandins, which have roles throughout the human body. They are hormones, in some respects. The omega-3 eicosapentaenoic acid (EPA), which can be made in the human body from the omega-3 essential fatty acid alpha-linolenic acid (ALA), or taken in through marine food sources, serves as a building block for series 3 prostaglandins (e.g. weakly inflammatory PGE3). The omega-6 dihomo-gamma-linolenic acid (DGLA) serves as a building block for series 1 prostaglandins

(e.g. anti-inflammatory PGE1), whereas arachidonic acid (AA) serves as a building block for series 2 prostaglandins (e.g. pro-inflammatory PGE 2). Both DGLA and AA can be made from the omega-6 linoleic acid (LA) in the human body, or can be taken in directly through food. An appropriately balanced intake of omega-3 and omega-6 partly determines the relative production of different prostaglandins, which is one reason why a balance between omega-3 and omega-6 is believed important for cardiovascular health. In industrialized societies, people typically consume large amounts of processed vegetable oils, which have reduced amounts of the essential fatty acids along with too much of omega-6 fatty acids relative to omega-3 fatty acids.

The conversion rate of omega-6 DGLA to AA largely determines the production of the prostaglandins PGE1 and PGE2. Omega-3 EPA prevents AA from being released from membranes, thereby skewing prostaglandin balance away from pro-inflammatory PGE2 (made from AA) toward anti-inflammatory PGE1 (made from DGLA). Moreover, the conversion (desaturation) of DGLA to AA is controlled by the enzymedelta-5-desaturase, which in turn is controlled by hormones such as insulin (up-regulation) and glucagon(down-regulation). The amount and type of carbohydrates consumed, along with some types of amino acid, can influence processes involving insulin, glucagon, and other hormones; therefore the ratio of omega-3 versus omega-6 has wide effects on general health, and specific effects on immune function and inflammation, and mitosis (i.e. cell division).

Protein



Proteins are chains of amino acids found in most nutritional foods.

Proteins are structural materials in much of the animal body (e.g. muscles, skin, and hair). They also form the enzymes that control chemical reactions throughout the body. Each protein

molecule is composed of amino acids, which are characterized by inclusion of nitrogen and sometimes sulphur (these components are responsible for the distinctive smell of burning protein, such as the keratin in hair). The body requires amino acids to produce new proteins (protein retention) and to replace damaged proteins (maintenance). As there is no protein or amino acid storage provision, amino acids must be present in the diet. Excess amino acids are discarded, typically in the urine. For all animals, some amino acids are essential (an animal cannot produce them internally) and some are non-essential (the animal can produce them from other nitrogen-containing compounds). About twenty amino acids are found in the human body, and about ten of these are essential and, therefore, must be included in the diet. A diet that contains adequate amounts of amino acids (especially those that are essential) is particularly important in some situations: during early development and maturation, pregnancy, lactation, or injury (a burn, for instance). A complete protein source contains all the essential amino acids; an incomplete protein source lacks one or more of the essential amino acids.

It is possible with protein combinations of two incomplete protein sources (e.g. rice and beans) to make a complete protein source, and characteristic combinations are the basis of distinct cultural cooking traditions. However, complementary sources of protein don't need to be eaten at the same meal to be used together by the body. Sources of dietary protein include meats, tofu and other soy-products, eggs, legumes, and dairy products such as milk and cheese. Excess amino acids from protein can be converted into glucose and used for fuel through a process called gluconeogenesis. The amino acids remaining after such conversion are discarded.

Minerals

Dietary minerals are the chemical elements required by living organisms, other than the four elementscarbon, hydrogen, nitrogen, and oxygen that are present in nearly all organic molecules. The term "mineral" is archaic, since the intent is to describe simply the less common elements in the diet. Some are heavier than the four just mentioned, including several metals, which often occur as ions in the body. Some dietitians recommend that these be supplied from foods in which they occur naturally, or at least as complex compounds, or sometimes even from natural inorganic sources (such as calcium carbonate from ground oyster shells). Some minerals are absorbed much more readily in the ionic forms found in such sources. On the other hand,

minerals are often artificially added to the diet as supplements; the most famous is likely iodine in iodized salt which prevents goiter.

Macrominerals

Many elements are essential in relative quantity; they are usually called "bulk minerals". Some are structural, but many play a role as electrolytes. Elements with recommended dietary allowance (RDA) greater than 200 mg/day are, in alphabetical order (with informal or folk-medicine perspectives in parentheses):

- Calcium, a common electrolyte, but also needed structurally (for muscle and digestive system health, bone strength, some forms neutralize acidity, may help clear toxins, provides signaling ions for nerve and membrane functions)
- Chlorine as chloride ions; very common electrolyte; see sodium, below
- Magnesium, required for processing ATP and related reactions (builds bone, causes strong peristalsis, increases flexibility, increases alkalinity)
- Phosphorus, required component of bones; essential for energy processing
- Potassium, a very common electrolyte (heart and nerve health)
- Sodium, a very common electrolyte; not generally found in dietary supplements, despite being needed in large quantities, because the ion is very common in food: typically as sodium chloride, or common salt. Excessive sodium consumption can deplete calcium and magnesium, leading to high blood pressure and osteoporosis.
- Sulfur, for three essential amino acids and therefore many proteins (skin, hair, nails, liver, and pancreas). Sulfur is not consumed alone, but in the form of sulfur-containing amino acids
- Trace minerals
- Many elements are required in trace amounts, usually because they play a catalytic role in enzymes. Some trace mineral elements (RDA < 200 mg/day) are, in alphabetical order:
- Cobalt required for biosynthesis of vitamin B12 family of coenzymes. Animals cannot biosynthesize B12, and must obtain this cobalt-containing vitamin in the diet
- Copper required component of many redox enzymes, including cytochrome c oxidase
- Chromium required for sugar metabolism

- Iodine required not only for the biosynthesis of thyroxine, but probably, for other important organs as breast, stomach, salivary glands, thymus etc. (see Extrathyroidal iodine); for this reason iodine is needed in larger quantities than others in this list, and sometimes classified with the macrominerals
- Iron required for many enzymes, and for hemoglobin and some other proteins
- Manganese (processing of oxygen)
- Molybdenum required for xanthine oxidase and related oxidases
- Nickel present in urease
- Selenium required for peroxidase (antioxidant proteins)
- Vanadium (Speculative: there is no established RDA for vanadium. No specific biochemical function has been identified for it in humans, although vanadium is required for some lower organisms.)
- Zinc required for several enzymes such as carboxypeptidase, liver alcohol dehydrogenase, and carbonic anhydrase
-

Vitamins

As with the minerals discussed above, some vitamins are recognized as essential nutrients, necessary in the diet for good health. (Vitamin D is the exception: it can be synthesized in the skin, in the presence ofUVB radiation.) Certain vitamin-like compounds that are recommended in the diet, such as carnitine, are thought useful for survival and health, but these are not "essential" dietary nutrients because the human body has some capacity to produce them from other compounds. Moreover, thousands of different phytochemicals have recently been discovered in food (particularly in fresh vegetables), which may have desirable properties including antioxidant activity (see below); however, experimental demonstration has been suggestive but inconclusive. Other essential nutrients that are not classified as vitamins include essential amino acids (see above), choline, essential fatty acids (see above), and the minerals discussed in the preceding section.

Vitamin deficiencies may result in disease conditions, including goitre, scurvy, osteoporosis, impaired immune system, disorders of cell metabolism, certain forms of cancer, symptoms of premature aging, and poor psychological health (including eating disorders), among many others. Excess levels of some vitamins are also dangerous to health (notably vitamin A), and for at least

one vitamin, B6, toxicity begins at levels not far above the required amount. Deficient or excess levels of minerals can also have serious health consequences.

Water

A manual water pump in China

Water is excreted from the body in multiple forms; includingurine and feces, sweating, and by water vapour in the exhaled breath. Therefore it is necessary to adequately rehydrate to replace lost fluids.

Early recommendations for the quantity of water required for maintenance of good health suggested that 6–8 glasses of water daily is the minimum to maintain proper hydration. However the notion that a person should consume eight glasses of water per day cannot be traced to a credible scientific source. The original water intake recommendation in 1945 by the Food and Nutrition Board of the National Research Council read: "An ordinary standard for diverse persons is 1 milliliter for each calorie of food. Most of this quantity is contained in prepared foods." More recent comparisons of well-known recommendations on fluid intake have revealed large discrepancies in the volumes of water we need to consume for good health. Therefore, to help standardize guidelines, recommendations for water consumption are included in two recent European Food Safety Authority (EFSA) documents (2010): (i) Food-based dietary guidelines and (ii) Dietary reference values for water or adequate daily intakes (ADI). These specifications were provided by calculating adequate intakes from measured intakes in populations of individuals with “desirable osmolarity values of urine and desirable water volumes per energy unit consumed.” For healthful hydration, the current EFSA guidelines recommend total water intakes of 2.0 L/day for adult females and 2.5 L/day for adult males. These reference values include water from drinking water, other beverages, and from food. About 80% of our daily water requirement comes from the beverages we drink, with the remaining 20% coming from food. Water content varies depending on the type of food consumed, with fruit and vegetables

containing more than cereals, for example. These values are estimated using country-specific food balance sheets published by the Food and Agriculture Organisation of the United Nations. Other guidelines for nutrition also have implications for the beverages we consume for healthy hydration- for example, the World Health Organization (WHO) recommend that added sugars should represent no more than 10% of total energy intake.

The EFSA panel also determined intakes for different populations. Recommended intake volumes in the elderly are the same as for adults as despite lower energy consumption, the water requirement of this group is increased due to a reduction in renal concentrating capacity. Pregnant and breastfeeding women require additional fluids to stay hydrated. The EFSA panel proposes that pregnant women should consume the same volume of water as non-pregnant women, plus an increase in proportion to the higher energy requirement, equal to 300 mL/day. To compensate for additional fluid output, breastfeeding women require an additional 700 mL/day above the recommended intake values for non-lactating women.

For those who have healthy kidneys, it is somewhat difficult to drink too much water, but (especially in warm humid weather and while exercising) it is dangerous to drink too little. While overhydration is much less common than dehydration, it is also possible to drink far more water than necessary which can result in water intoxication, a serious and potentially fatal condition. In particular, large amounts of de-ionized water are dangerous.

Chapter 9

Other nutrients

Other micronutrients include antioxidants and phytochemicals. These substances are generally more recent discoveries that have not yet been recognized as vitamins or as required. Phytochemicals may act as antioxidants, but not all phytochemicals are antioxidants.

Antioxidants

Colorful fruits are important components of a healthy diet.

As cellular metabolism/energy production requires oxygen, potentially damaging (e.g. mutation causing) compounds known as free radicals can form. Most of these are oxidizers (i.e. acceptors of electrons) and some react very strongly. For the continued normal cellular maintenance, growth, and division, these free radicals must be sufficiently neutralized by antioxidant compounds. Recently, some researchers suggested an interesting theory of evolution of dietary antioxidants. Some are produced by the human body with adequate precursors (glutathione, Vitamin C), and those the body cannot produce may only be obtained in the diet via direct sources (Vitamin C in humans, Vitamin A, Vitamin K) or produced by the body from other compounds (Beta-carotene converted to Vitamin A by the body, Vitamin D synthesized from cholesterol by sunlight). Phytochemicals (Section Below) and their subgroup, polyphenols, make up the majority of antioxidants; about 4,000 are known. Different antioxidants are now known to function in a cooperative network. For example, Vitamin C can reactivate free radical-containing glutathione or Vitamin E by accepting the free radical itself. Some antioxidants are more effective than others at neutralizing different free radicals. Some cannot neutralize certain free radicals. Some cannot be present in certain areas of free radical development (Vitamin A is fat-soluble and protects fat areas, Vitamin C is water soluble and protects those areas). When interacting with a free radical, some antioxidants produce a different free radical compound that

is less dangerous or more dangerous than the previous compound. Having a variety of antioxidants allows any byproducts to be safely dealt with by more efficient antioxidants in neutralizing a free radical's butterfly effect.

Although initial studies suggested that antioxidant supplements might promote health, later large clinical trials did not detect any benefit and suggested instead that excess supplementation may be harmful.

Phytochemicals

Blackberries are a source ofpolyphenol antioxidants

Phytochemicals are chemical compounds which occur naturally in plants (phyto means "plant" in Greek). The term is generally used to refer to those chemicals that may have biological significance, for example antioxidants.

There is research interest in the health effects of phytochemicals, but to date there is no conclusive evidence. While many fruits and vegetables which happen to contain phytochemicals are thought to be components of a healthy diet, by comparison dietary supplements based on them have no proven health benefit.

Intestinal bacterial flora

It is now also known that animal intestines contain a large population of gut flora. In humans, these include species such as Bacteroides, L. acidophilus and E. coli, among many others. They are essential todigestion, and are also affected by the food we eat. Bacteria in the gut perform many important functions for humans, including breaking down and aiding in the absorption of otherwise indigestible food; stimulating cell growth; repressing the growth of harmful bacteria,

training the immune system to respond only to pathogens; producing vitamin B12, and defending against some infectious diseases.

Advice and guidance

U.S. Government policies

In the US, dietitians are registered (RD) or licensed (LD) with the Commission for Dietetic Registration and the American Dietetic Association, and are only able to use the title "dietitian," as described by the business and professions codes of each respective state, when they have met specific educational and experiential prerequisites and passed a national registration or licensure examination, respectively. In California, registered dietitians must abide by the "Business and Professions Code of Section 2585-2586.8".Anyone may call themselves a nutritionist, including unqualified dietitians, as this term is unregulated. Some states, such as the State of Florida, have begun to include the title "nutritionist" in state licensure requirements. Most governments provide guidance on nutrition, and some also impose mandatory disclosure/labeling requirements for processed food manufacturers and restaurants to assist consumers in complying with such guidance.

In the US, nutritional standards and recommendations are established jointly by the US Department of Agriculture and US Department of Health and Human Services. Dietary and physical activity guidelines from the USDA are presented in the concept of My Plate, which superseded the food pyramid, which replaced the Four Food Groups. The Senate committee currently responsible for oversight of the USDA is the Agriculture, Nutrition and Forestry Committee. Committee hearings are often televised on C-SPAN.

The U.S. Department of Health and Human Services provides a sample week-long menu which fulfills the nutritional recommendations of the government. Canada's Food Guide is another governmental recommendation.

Government programs

Federal and state governmental organizations have been working on nutrition literacy interventions in non-primary health care settings to address the nutrition information problem in the U.S. Some programs include:

The Family Nutrition Program (FNP) is a free nutrition education program serving low-income adults around the U.S. This program is funded by the Food Nutrition Service's (FNS) branch of the United States Department of Agriculture (USDA) usually through a local state academic institution which runs the program. The FNP has developed a series of tools to help families participating in the Food Stamp Program stretch their food dollar and form healthful eating habits including nutrition education.

Expanded Food and Nutrition Education Program (ENFEP) is a unique program that currently operates in all 50 states and in American Samoa, Guam, Micronesia, Northern Marianas, Puerto Rico, and the Virgin Islands. It is designed to assist limited-resource audiences in acquiring the knowledge, skills, attitudes, and changed behavior necessary for nutritionally sound diets, and to contribute to their personal development and the improvement of the total family diet and nutritional well-being.

An example of a state initiative to promote nutrition literacy is Smart Bodies, a public-private partnership between the state's largest university system and largest health insurer, Louisiana State Agricultural Center and Blue Cross and Blue Shield of Louisiana Foundation. Launched in 2005, this program promotes lifelong healthful eating patterns and physically active lifestyles for children and their families. It is an interactive educational program designed to help prevent childhood obesity through classroom activities that teach children healthful eating habits and physical exercise.

Teaching

Nutrition is taught in schools in many countries. In England and Wales the Personal and Social Education and Food Technology curricula include nutrition, stressing the importance of a balanced diet and teaching how to read nutrition labels on packaging. In many schools a Nutrition class will fall within the Family and Consumer Science or Health departments. In some American schools, students are required to take a certain number of FCS or Health related classes. Nutrition is offered at many schools, and if it is not a class of its own, nutrition is included in other FCS or Health classes such as: Life Skills, Independent Living, Single Survival, Freshmen Connection, Health etc. In many Nutrition classes, students learn about the food groups, the food pyramid, Daily Recommended Allowances, calories, vitamins, minerals,

malnutrition, physical activity, healthful food choices, portion sizes and how to live a healthy life.

A 1985 US National Research Council report entitled Nutrition Education in US Medical Schools concluded that nutrition education in medical schools was inadequate. Only 20% of the schools surveyed taught nutrition as a separate, required course. A 2006 survey found that this number had risen to 30%.

Healthy diets

Whole plant food diet

Heart disease, cancer, obesity, and diabetes are commonly called "Western" diseases because these maladies were once rarely seen in developing countries. An international study in China found some regions had essentially no cancer or heart disease, while in other areas they reflected "up to a 100-fold increase" coincident with shifts from diets that were found to be entirely plant-based to heavily animal-based, respectively. In contrast, diseases of affluence like cancer and heart disease are common throughout the developed world, including the United States. Adjusted for age and exercise, large regional clusters of people in China rarely suffered from these "Western" diseases possibly because their diets are rich in vegetables, fruits and whole grains, and have little dairy and meat products. Some studies show these to be, in high quantities, possible causes of some cancers. There are arguments for and against this controversial issue.

The United Healthcare/Pacificare nutrition guideline recommends a whole plant food diet, and recommends using protein only as a condiment with meals. A National Geographic cover article from November 2005, entitled The Secrets of Living Longer, also recommends a whole plant food diet. The article is a lifestyle survey of three populations, Sardinians, Okinawans, and Adventists, who generally display longevity and "suffer a fraction of the diseases that commonly kill people in other parts of the developed world, and enjoy more healthy years of life." In sum, they offer three sets of 'best practices' to emulate. The rest is up to you. In common with all three groups is to "Eat fruits, vegetables, and whole grains."

The National Geographic article noted that an NIH funded study of 34,000 Seventh-day Adventists between 1976 and 1988 "...found that the Adventists' habit of consuming beans, soy milk, tomatoes, and other fruits lowered their risk of developing certain cancers. It also

suggested that eating whole grain bread, drinking five glasses of water a day, and, most surprisingly, consuming four servings of nuts a week reduced their risk of heart disease."

The French "paradox"

The French paradox is the observation that the French suffer a relatively low incidence of coronary heart disease, despite having a diet relatively rich in saturated fats. A number of explanations have been suggested:

- Saturated fat consumption does not cause heart disease
- Reduced consumption of processed carbohydrate and other junk foods.
- Regular consumption of red wine.
- More active lifestyles involving plenty of daily exercise, especially walking; the French are much less dependent on cars than Americans are.
- Higher consumption of artificially produced trans-fats by Americans, which has been shown to have greater lipoprotein effects per gram than saturated fat.

However, statistics collected by the World Health Organization from 1990–2000 show that the incidence of heart disease in France may have been underestimated and, in fact, may be similar to that of neighboring countries.

Sports nutrition

Protein

Protein milkshakes, made from protein powder (center) and milk (left), are a common bodybuilding supplement.

Protein is an important component of every cell in the body. Hair and nails are mostly made of protein. The body uses protein to build and repair tissues. In addition, protein is used to make hormones and other chemicals in the body. Protein is also an important building block of bones, muscles, cartilage, skin, and blood.

The protein requirement for each individual differs, as do opinions about whether and to what extent physically active people require more protein. The 2005 Recommended Dietary Allowances (RDA), aimed at the general healthy adult population, provide for an intake of 0.8 – 1 grams of protein per kilogram of body weight (according to the BMI formula), with the review panel stating that "no additional dietary protein is suggested for healthy adults undertaking resistance or endurance exercise". Conversely, Di Pasquale (2008), citing recent studies, recommends a minimum protein intake of 2.2 g/kg "for anyone involved in competitive or intense recreational sports who wants to maximize lean body mass but does not wish to gain weight".

Water and salts

Water is one of the most important nutrients in the sports diet. It helps eliminate food waste products in the body, regulates body temperature during activity and helps with digestion. Maintaining hydration during periods of physical exertion is key to peak performance. While drinking too much water during activities can lead to physical discomfort, dehydration in excess of 2% of body mass (by weight) markedly hinders athletic performance. Additional carbohydrates and protein before, during, and after exercise increase time to exhaustion as well as speed recovery. The amount of water needed is based on work performed, lean body mass, and environmental factors, especially ambient temperature and humidity. Maintaining the right amount is key.

Carbohydrates

The main fuel used by the body during exercise is carbohydrates, which are stored in muscle as glycogen—a form of sugar. During exercise, muscle glycogen reserves can be used up, especially when activities last longer than 90 min. Because the amount of glycogen stored in the body is limited, it is important for athletes to replace glycogen by consuming a diet high in

carbohydrates. Meeting energy needs can help improve performance during the sport, as well as improve overall strength and endurance.

Nutrition literacy

At the time of this entry, we were not able to identify any specific nutrition literacy studies in the U.S. at a national level. However, the findings of the 2003 National Assessment of Adult Literacy (NAAL) provide a basis upon which to frame the nutrition literacy problem in the U.S. NAAL introduced the first ever measure of "the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions," – an objective of Healthy People 2010 and of which nutrition literacy might be considered an important subset. On a scale of below basic, basic, intermediate and proficient, NAAL found 13 percent of adult Americans have proficient health literacy, 44% have intermediate literacy, 29 percent have basic literacy and 14 percent have below basic health literacy. The study found that health literacy increases with education and people living below the level of poverty have lower health literacy than those above it.

Another study examining the health and nutrition literacy status of residents of the lower Mississippi Delta found that 52 percent of participants had a high likelihood of limited literacy skills. While a precise comparison between the NAAL and Delta studies is difficult, primarily because of methodological differences, Zoellner et al. suggest that health literacy rates in the Mississippi Delta region are different from the U.S. general population and that they help establish the scope of the problem of health literacy among adults in the Delta region. For example, only 12 percent of study participants identified the My Pyramid graphic two years after it had been launched by the USDA. The study also found significant relationships between nutrition literacy and income level and nutrition literacy and educational attainment further delineating priorities for the region.

These statistics point to the complexities surrounding the lack of health/nutrition literacy and reveal the degree to which they are embedded in the social structure and interconnected with other problems. Among these problems are the lack of information about food choices, the lack of understanding nutritional information and its application to individual circumstances, limited or difficult access to healthful foods, and a range of cultural influences and socioeconomic

constraints such as low levels of education and high levels of poverty that decrease opportunities for healthful eating and living.

The links between low health literacy and poor health outcomes has been widely documented and there is evidence that some interventions to improve health literacy have produced successful results in the primary care setting. More must be done to further our understanding of nutrition literacy specific interventions in non-primary care settings in order to achieve better health outcomes.

Chapter 10

Malnutrition

Malnutrition refers to insufficient, excessive, or imbalanced consumption of nutrients by an organism. In developed countries, the diseases of malnutrition are most often associated with nutritional imbalances or excessive consumption.

Although there are more organisms in the world who are malnourished due to insufficient consumption, increasingly more organisms suffer from excessive over-nutrition; a problem caused by an over abundance of sustenance coupled with the instinctual desire (by animals in particular) to consume all that it can.

Nutritionism is the view that excessive reliance on food science and the study of nutrition can, paradoxically, lead to poor nutrition and to ill health. It was originally credited to Gyorgy Scrinis, and was popularized by Michael Pollan. Since nutrients are invisible, policy makers rely on nutrition experts to advise on food choices. Because science has an incomplete understanding of how food affects the human body, Pollan argues, nutritionism can be blamed for many of the health problems relating to diet in the Western World today.

Insufficient

Under consumption generally refers to the long-term consumption of insufficient sustenance in relation to the energy that an organism expends or expels, leading to poor health.

Excessive

Over consumption generally refers to the long-term consumption of excess sustenance in relation to the energy that an organism expends or expels, leading to poor health and, in animals, obesity. It can cause excessive hair loss, brittle nails, and irregular premenstrual cycles for females.

Unbalanced

When too much of one or more nutrients is present in the diet to the exclusion of the proper amount of other nutrients, the diet is said to be unbalanced.

Illnesses caused by improper nutrient consumption

Nutrients	Deficiency	Excess
Macronutrients		
Calories	Starvation, marasmus	Obesity, diabetes mellitus, cardiovascular disease
Simple carbohydrates	Low energy levels.	Obesity, diabetes mellitus, cardiovascular disease
Complex carbohydrates	Micronutrient deficiency	Obesity, cardiovascular disease (high glycemic index foods)
Protein	Kwashiorkor	Rabbit starvation, ketoacidosis (in diabetics)
Saturated fat	Low testosterone levels, vitamin deficiencies.	Obesity, cardiovascular disease
Trans fat	None	Obesity, cardiovascular disease
Unsaturated fat	Fat-soluble vitamin deficiency	Obesity, cardiovascular disease

Micronutrients		
Vitamin A	Xerophthalmia and night blindness	Hypervitaminosis A (cirrhosis, hair loss)
Vitamin B_1	Beri-Beri	?
Vitamin B_2	Skin and corneal lesions	?
Niacin	Pellagra	Dyspepsia, cardiac arrhythmias, birth defects
Vitamin B_{12}	Pernicious anemia	?
Vitamin C	Scurvy	Diarrhea causing dehydration
Vitamin D	Rickets	Hypervitaminosis D (dehydration, vomiting, constipation)
Vitamin E	Neurological disease	Hypervitaminosis E (anticoagulant: excessive bleeding)

Vitamin K	Hemorrhage	Liver damage
Omega-3 fats	Cardiovascular Disease	Bleeding, Hemorrhages, Hemorrhagic stroke, reduced glycemic control among diabetics
Omega-6 fats	None	Cardiovascular Disease, Cancer
Cholesterol	None	Cardiovascular Disease
Macrominerals		
Calcium	Osteoporosis, tetany, carpopedal spasm, laryngospasm, cardiac arrhythmias	Fatigue, depression, confusion, nausea, vomiting,constipation, pancreatitis, increased urination, kidney stones
Magnesium	Hypertension	Weakness, nausea, vomiting, impaired breathing, and hypotension
Potassium	Hypokalemia, cardiac arrhythmias	Hyperkalemia, palpitations
Sodium	Hyponatremia	Hypernatremia, hypertension

Trace minerals		
Iron	Anemia	Cirrhosis, Hereditary hemochromatosis, heart disease
Iodine	Goiter, hypothyroidism	Iodine toxicity (goiter, hypothyroidism)

Mental agility

Research indicates that improving the awareness of nutritious meal choices and establishing long-term habits of healthful eating have a positive effect on cognitive and spatial memory capacity, potentially increasing a student's potential to process and retain academic information.

Some organizations have begun working with teachers, policymakers, and managed foodservice contractors to mandate improved nutritional content and increased nutritional resources in school cafeterias from primary to university level institutions. Health and nutrition have been proven to have close links with overall educational success. Currently, less than 10% of American college students report that they eat the recommended five servings of fruit and vegetables daily. Better nutrition has been shown to have an impact on both cognitive and spatial memory performance; a study showed those with higher blood sugar levels performed better on certain memory tests. In another study, those who consumed yogurt performed better on thinking tasks when compared to those who consumed caffeine free diet soda or confections. Nutritional deficiencies have been shown to have a negative effect on learning behavior in mice as far back as 1951.

"Better learning performance is associated with diet induced effects on learning and memory ability".

The "nutrition-learning nexus" demonstrates the correlation between diet and learning and has application in a higher education setting.

"We find that better nourished children perform significantly better in school, partly because they enter school earlier and thus have more time to learn but mostly because of greater learning productivity per year of schooling."

91% of college students feel that they are in good health while only 7% eat their recommended daily allowance of fruits and vegetables.

Nutritional education is an effective and workable model in a higher education setting.

More "engaged" learning models that encompass nutrition is an idea that is picking up steam at all levels of the learning cycle.

There is limited research available that directly links a student's Grade Point Average (G.P.A.) to their overall nutritional health. Additional substantive data is needed to prove that overall intellectual health is closely linked to a person's diet, rather than just another correlation fallacy.

Mental disorders

Nutritional supplement treatment may be appropriate for major depression, bipolar disorder, schizophrenia, and obsessive compulsive disorder, the four most common mental disorders in developed countries. Supplements that have been studied most for mood elevation and stabilization include eicosapentaenoic acid and docosahexaenoic acid (each of which are an omega-3 fatty acid contained in fish oil, but not inflaxseed oil), vitamin B12, folic acid, and inositol.

Cancer

Cancer is now common in developing countries. According to a study by the International Agency for Research on Cancer, "In the developing world, cancers of the liver, stomach and esophagus were more common, often linked to consumption of carcinogenic preserved foods, such as smoked or salted food, and parasitic infections that attack organs." Lung cancer rates are rising rapidly in poorer nations because of increased use of tobacco. Developed countries "tended to have cancers linked to affluence or a 'Western lifestyle' — cancers of the colon, rectum, breast and prostate — that can be caused by obesity, lack of exercise, diet and age."

Metabolic syndrome

Several lines of evidence indicate lifestyle-induced hyperinsulinemia and reduced insulin function (i.e. insulin resistance) as a decisive factor in many disease states. For example, hyperinsulinemia and insulin resistance are strongly linked to chronic inflammation, which in turn is strongly linked to a variety of adverse developments such as arterial microinjuries and clot formation (i.e. heart disease) and exaggerated cell division (i.e. cancer). Hyperinsulinemia and insulin resistance (the so-called metabolic syndrome) are characterized by a combination of abdominal obesity, elevated blood sugar, elevated blood pressure, elevated blood triglycerides,

and reduced HDL cholesterol. The negative impact of hyperinsulinemia on prostaglandin PGE1/PGE2 balance may be significant.

The state of obesity clearly contributes to insulin resistance, which in turn can cause type 2 diabetes. Virtually all obese and most type 2 diabetic individuals have marked insulin resistance. Although the association between overweight and insulin resistance is clear, the exact (likely multifarious) causes of insulin resistance remain less clear. Importantly, it has been demonstrated that appropriate exercise, more regular food intake and reducing glycemic load (see below) all can reverse insulin resistance in overweight individuals (and thereby lower blood sugar levels in those who have type 2 diabetes).

Obesity can unfavourably alter hormonal and metabolic status via resistance to the hormone leptin, and a vicious cycle may occur in which insulin/leptin resistance and obesity aggravate one another. The vicious cycle is putatively fuelled by continuously high insulin/leptin stimulation and fat storage, as a result of high intake of strongly insulin/leptin stimulating foods and energy. Both insulin and leptin normally function as satiety signals to the hypothalamus in the brain; however, insulin/leptin resistance may reduce this signal and therefore allow continued overfeeding despite large body fat stores. In addition, reduced leptin signalling to the brain may reduce leptin's normal effect to maintain an appropriately high metabolic rate.

There is a debate about how and to what extent different dietary factors— such as intake of processed carbohydrates, total protein, fat, and carbohydrate intake, intake of saturated and trans fatty acids, and low intake of vitamins/minerals—contribute to the development of insulin and leptin resistance. In any case, analogous to the way modern man-made pollution may potentially overwhelm the environment's ability to maintain homeostasis, the recent explosive introduction of high glycemic index and processed foods into the human diet may potentially overwhelm the body's ability to maintain homeostasis and health (as evidenced by the metabolic syndrome epidemic).

Hyponatremia

Excess water intake, without replenishment of sodium and potassium salts, leads to hyponatremia, which can further lead to water intoxication at more dangerous levels. A well-publicized case occurred in 2007, when Jennifer Strange died while participating in a water-drinking contest. More usually, the condition occurs in long-distance endurance events (such as

marathon or triathlon competition and training) and causes gradual mental dulling, headache, drowsiness, weakness, and confusion; extreme cases may result in coma, convulsions, and death. The primary damage comes from swelling of the brain, caused by increased osmosis as blood salinity decreases. Effective fluid replacement techniques include water aid stations during running/cycling races, trainers providing water during team games, such as soccer, and devices such as Camel Baks, which can provide water for a person without making it too hard to drink the water.

Antinutrient

Antinutrients are natural or synthetic compounds that interfere with the absorption of nutrients. Nutrition studies focus on antinutrients commonly found in food sources and beverages.

Chapter 11

Processed foods

Since the Industrial Revolution some two hundred years ago, the food processing industry has invented many technologies that both help keep foods fresh longer and alter the fresh state of food as they appear in nature. Cooling is the primary technology used to maintain freshness, whereas many more technologies have been invented to allow foods to last longer without becoming spoiled. These latter technologies includepasteurisation, autoclavation, drying, salting, and separation of various components, all of which appear to alter the original nutritional contents of food. Pasteurisation and autoclavation (heating techniques) have no doubt improved the safety of many common foods, preventing epidemics of bacterial infection. But some of the (new) food processing technologies undoubtedly have downfalls as well.

Modern separation techniques such as milling, centrifugation, and pressing have enabled concentration of particular components of food, yielding flour, oils, juices and so on, and even separate fatty acids, amino acids, vitamins, and minerals. Inevitably, such large scale concentration changes the nutritional content of food, saving certain nutrients while removing others. Heating techniques may also reduce food's content of many heat-labile nutrients such as certain vitamins and phytochemicals, and possibly other yet to be discovered substances. Because of reduced nutritional value, processed foods are often 'enriched' or 'fortified' with some of the most critical nutrients (usually certain vitamins) that were lost during processing. Nonetheless, processed foods tend to have an inferior nutritional profile compared to whole, fresh foods, regarding content of both sugar and high GI starches, potassium/sodium, vitamins, fiber, and of intact, unoxidized (essential) fatty acids. In addition, processed foods often contain potentially harmful substances such as oxidized fats and trans fatty acids.

A dramatic example of the effect of food processing on a population's health is the history of epidemics ofberi-beri in people subsisting on polished rice. Removing the outer layer of rice by polishing it removes with it the essential vitamin thiamine, causing beri-beri. Another example is the development of scurvy among infants in the late 19th century in the United States. It turned out that the vast majority of sufferers were being fed milk that had been heat-treated (as suggested by Pasteur) to control bacterial disease. Pasteurisation was effective against bacteria, but it destroyed the vitamin C.

As mentioned, lifestyle- and obesity-related diseases are becoming increasingly prevalent all around the world. There is little doubt that the increasingly widespread application of some modern food processing technologies has contributed to this development. The food processing industry is a major part of modern economy, and as such it is influential in political decisions (e.g. nutritional recommendations, agricultural subsidising). In any known profit-driven economy, health considerations are hardly a priority; effective production of cheap foods with a long shelf-life is more the trend. In general, whole, fresh foods have a relatively short shelf-life and are less profitable to produce and sell than are more processed foods. Thus, the consumer is left with the choice between more expensive, but nutritionally superior, whole, fresh foods, and cheap, usually nutritionally inferior, processed foods. Because processed foods are often cheaper, more convenient (in both purchasing, storage, and preparation), and more available, the consumption of nutritionally inferior foods has been increasing throughout the world along with many nutrition-related health complications.

History

Antiquity

Hippocrates lived about 400 BC, yet Galen and the understanding of nutrition followed him for centuries.

According to Walter Gratzer, the study of nutrition probably began during the 6th century BC. In China the concept of Qi developed, a spirit or "wind" similar to what Western Europeans later called pneuma. Food was classified into "hot" (for example, meats, blood, ginger and hot spices) and "cold" (green vegetables) in China, India, Malaya and Persia. Humours developed perhaps first in China alongside qi. Ho the Physician concluded that diseases are caused by deficiencies of elements (Wu Xing: fire, water, earth, wood and metal), and he classified diseases as well as prescribed diets. About the same time in Italy, Alcmaeon of Croton (a Greek) wrote of the importance of equilibrium between what goes in and what goes out, and warned that imbalance would result disease marked by obesity or emaciation.

Around 475 BC, Anaxagoras stated that food is absorbed by the human body and therefore contained "homeomerics" (generative components), suggesting the existence of nutrients. Around 400 BC, Hippocrates, who recognized and was concerned with obesity which may have been common in southern Europe at the time, said, "Let food be your medicine and medicine be

your food." The book that is still attributed to him, Corpus Hippocraticum, called for moderation and emphasized exercise.

Mistaken, but followed for a millennium and a half, Galen (1st century) created the first coherent theory of nutrition.

Salt, pepper and other spices were prescribed for various ailments in various preparations for example mixed with vinegar. In the 2nd century BC, Cato the Elder believed that cabbage (or the urine of cabbage-eaters) could cure digestive diseases, ulcers, warts and intoxication. Living about the turn of the millennium, Aulus Celsus, a Roman doctor, believed in "strong" and "weak" foods (bread for example was strong, as were older animals and vegetables).

Galen to Lind

It is hard to overlook the doctrines of Galen: in use from his life in the 1st century AD until the 17th century–it was heresy to disagree with him for 1500 years.[79] Galen was physician to gladiators in Pergamon, and inRome, physician to Marcus Aurelius and the three emperors who succeeded him.[80] Most of Galen's teachings were gathered and enhanced in the late 11th century by Benedictine monks at the School of Salerno in Regimen sanitatis Salernitanum which still had users in the 17th century.[81] Galen believed in the bodily humours of Hippocrates, and he taught that pneuma is the source of life. Four elements (earth, air, fire and water) combine into "complexion" which combines into states (the four temperaments: sanguine, phlegmatic, choleric, and melancholic). The states are made up of pairs of attributes (hot and moist, cold and moist, hot and dry, and cold and dry) which are made of four humours: blood, phlegm, green (or yellow) bile, and black bile (the bodily form of the elements). Galen thought that for a person to have gout, kidney stones, or arthritis was scandalous, which Gratzer likens to Samuel Butler's Erehwon (1872) where sickness is a crime.

James Lind conducted in 1747 the first controlled clinical trial in modern times, and in 1753 published Treatise on Scurvy.

In the 1500s, Paracelsus was probably the first to criticize Galen publicly. Also in the 16th century, scientist and artist Leonardo da Vinci compared metabolism to a burning candle. Leonardo didn't publish his works on this subject, but he wasn't afraid of thinking for himself and he definitely disagreed with Galen. Ultimately, 16th century works of Andreas Vesalius,

sometimes called the father of modern medicine, overturned Galen's ideas. He was followed by piercing thought amalgamated with the era's mysticism and religion sometimes fueled by the mechanics of Newton and Galileo. Jan Baptist van Helmont, who discovered several gases such as carbon dioxide, performed the first quantitative experiment. Robert Boyle advancedchemistry. Sanctorius measured body weight. Physician Herman Boerhaave modeled the digestive process. Physiologist Albrecht von Haller worked out the difference between nerves and muscles.

Sometimes overlooked during his life, James Lind, a physician in the British navy, performed the first scientific nutrition experiment in 1747, discovering that lime juice saved sailors who had been at sea for years from scurvy, a deadly and painful bleeding disorder. The discovery was ignored for forty years, after which British sailors became known as "limeys."

The essential vitamin C within lime juice would not be identified by scientists until the 1930s.

Lavoisier and modern science

By containing his assistant, Armand Seguin, inside a rubber suit fitted with a tube sealed to his mouth with putty,Antoine Lavoisier first measured basal metabolic rate.[86] Drawing by Madame Lavoisier (seated at right).

Around 1770, Antoine Lavoisier discovered the details of metabolism, demonstrating that the oxidation of food is the source of body heat. He discovered the principle of conservation of mass. His ideas made the phlogiston theory of combustion obsolete.

In 1790, George Fordyce recognized calcium as necessary for fowl survival. In the early 19th century, the elements carbon, nitrogen, hydrogen and oxygen were recognized as the primary components of food, and methods to measure their proportions were developed.[citation needed]

In 1816, François Magendie discovered that dogs fed only carbohydrates (sugar), fat (olive oil) and water died evidently of starvation, but dogs also fed protein survived, identifying protein as an essential dietary component. William Prout in 1827 was the first person to divide foods into carbohydrates, fat, and protein. During the 19th century, Jean-Baptiste Dumas and Justus von Liebig quarrelled over their shared belief that animals get their protein directly from plants (animal and plant protein are the same and that humans do not create organic compounds). With a reputation as the leading organic chemist of his day but with no credentials in animal physiology, Liebig grew rich making food extracts like beef boullion and infant formula that were later found to be of questionable nutritious value. In the 1860s, Claude Bernard discovered

that body fat can be synthesized from carbohydrate and protein, showing that the energy in blood glucose can be stored as fat or as glycogen.

In the early 1880s, Kanehiro Takaki observed that Japanese sailors (whose diets consisted almost entirely of white rice) developed beriberi (or endemic neuritis, a disease causing heart problems and paralysis), but British sailors and Japanese naval officers did not. Adding various types of vegetables and meats to the diets of Japanese sailors prevented the disease, (not because of the increased protein as Takaki supposed, but because it introduced a few parts per million of thiamine to the diet, later understood as a cure).

In 1896, Eugen Baumann observed iodine in thyroid glands. In 1897, Christiaan Eijkman worked with natives of Java, who also suffered from beriberi. Eijkman observed that chickens fed the native diet of white rice developed the symptoms of beriberi, but remained healthy when fed unprocessed brown rice with the outer bran intact. Eijkman cured the natives by feeding them brown rice, discovering that food can cure disease. Over two decades later, nutritionists learned that the outer rice bran contains vitamin B1, also known as thiamine.

From 1900 to the present

Frederick Hopkinsdiscovered vitamins, for which he shared a Nobel prize with Eijkman.

In the early 20th century, Carl von Voit and Max Rubner independently measured caloric energy expenditure in different species of animals, applying principles of physics in nutrition. In 1906, Wilcock and Hopkins showed that the amino acid tryptophan was necessary for the survival of rats. He fed them a special mixture of food containing all the nutrients he believed were essential for survival, but the rats died. A second group of rats were fed an amount of milk containing vitamins. Sir Frederick Hopkinsrecognized "accessory food factors" other than calories, protein andminerals, as organic materials essential to health, but which the body cannot synthesize. In 1907, Stephen M. Babcock and Edwin B. Hartconducted the single-grain experiment, which took nearly four years to complete.

Vitamin	Year Isolated
Thiamin	1926
Vitamin C	1926
Vitamin A	1939
Vitamin D	1931
Vitamin E	1936

Niacin	1937
Biotin	1939
Vitamin K	1939
Pantothenic acid	1939
Folate	1939
Riboflavin	1933
Vitamin B6	1936

Oxford University closed down its nutrition department after World War II because the subject seemed to have been completed between 1912 and 1944.

In 1912, Casimir Funkcoined the term vitamin, a vital factor in the diet, from the words "vital" and "amine," because these unknown substances preventing scurvy, beriberi, and pellagra, were thought then to be derived from ammonia. The vitamins were studied in the first half of the 20th century.

In 1913, Elmer McCollum discovered the first vitamins, fat soluble vitamin A, and water soluble vitamin B (in 1915; now known to be a complex of several water-soluble vitamins) and named vitamin C as the then-unknown substance preventing scurvy. Lafayette Mendel and Thomas Osborne also performed pioneering work on vitamins A and B. In 1919, Sir Edward Mellanby incorrectly identified rickets as a vitamin A deficiency because he could cure it in dogs with cod liver oil. In 1922, Elmer McCollum destroyed the vitamin A in cod liver oil, but found that it still cured rickets. Also in 1922, H.M. Evans and L.S. Bishop discover vitamin E as essential for rat pregnancy, originally calling it "food factor X" until 1925.

In 1925, Hart discovered that trace amounts of copper are necessary for iron absorption. In 1927, Adolf Otto Reinhold Windaus synthesized vitamin D, for which he won theNobel Prize in Chemistry in 1928. In 1928, Albert Szent-Györgyi isolated ascorbic acid, and in 1932 proved that it is vitamin C by preventing scurvy. In 1935 he synthesized it, and in 1937, he won a Nobel Prize for his efforts. Szent-Györgyi concurrently elucidated much of the citric acid cycle.

In the 1930s, William Cumming Rose identified essential amino acids, necessary protein components which the body cannot synthesize. In 1935, Underwood and Marston independently discovered the necessity ofcobalt. In 1936, Eugene Floyd DuBois showed that work and school performance are related to caloric intake. In 1938, Erhard Fernholz discovered the chemical

structure of vitamin E and then he tragically disappeared.[98][99] It was synthesised the same year by Paul Karrer.

In 1940, rationing in the United Kingdom during and after World War II took place according to nutritional principles drawn up by Elsie Widdowson and others. In 1941, the first Recommended Dietary Allowances(RDAs) were established by the National Research Council.

In 1992, The U.S. Department of Agriculture introduced the Food Guide Pyramid. In 2002, a Natural Justicestudy showed a relation between nutrition and violent behavior[citation needed]. In 2005, one inconclusive study found that obesity could be caused by adenovirus in addition to bad nutrition.

World leaders are looking at alternatives like genetically modified foods to tackle the problem of world hunger and food shortages.

Plant nutrition

T. Colin Campbell is among the scientists who advocate aplant-based diet

Plant nutrition is the study of the chemical elements that are necessary for plant growth. There are several principles that apply to plant nutrition. Some elements are directly involved in plant metabolism. However, this principle does not account for the so-called beneficial elements, whose presence, while not required, has clear positive effects on plant growth.

A nutrient that is able to limit plant growth according to Liebig's law of the minimum, is considered an essential plant nutrient if the plant cannot complete its full life cycle without it. There are 16 essential plant soil nutrients, besides the three major elemental nutrients carbon and oxygen which are obtained by photosynthetic plants from carbon dioxide in air, and hydrogen, which is obtained from water.

Macronutrients (not counting oxygen, carbon, and hydrogen):

- N = Nitrogen
- P = Phosphorus
- K = Potassium
- Ca = Calcium
- Mg = Magnesium
- S = Sulfur
- Si = Silicon

Micronutrients (trace levels) include:

- Cl = Chlorine
- Fe = Iron
- B = Boron
- Mn = Manganese
- Na = Sodium
- Zn = Zinc
- Cu = Copper
- Ni= Nickel
- Mo = Molybdenum

Macronutrients

Calcium

Calcium regulates transport of other nutrients into the plant and is also involved in the activation of certain plant enzymes. Calcium deficiency results in stunting.

Nitrogen

Nitrogen is an essential component of all proteins. Nitrogen deficiency most often results in stunted growth.

Phosphorus

Phosphorus is important in plant bioenergetics. As a component of ATP, phosphorus is needed for the conversion of light energy to chemical energy (ATP) during photosynthesis. Phosphorus can also be used to modify the activity of various enzymes by phosphorylation, and can be used for cell signaling. Since ATP can be used for the biosynthesis of many plant biomolecules, phosphorus is important for plant growth and flower/seed formation.

Potassium

Potassium regulates the opening and closing of the stoma by a potassium ion pump. Since stomata are important in water regulation, potassium reduces water loss from the leaves and increases droughttolerance. Potassium deficiency may cause necrosis or interveinal chlorosis.

Silicon

Silicon is deposited in cell walls and contributes to its mechanical properties including rigidity andelasticity.

Micronutrients

Boron

Boron is important in sugar transport, cell division, and synthesizing certain enzymes. Boron deficiencycauses necrosis in young leaves and stunting.

Copper

Copper is important for photosynthesis. Symptoms for copper deficiency include chlorosis. Involved in many enzyme processes. Necessary for proper photosynthesis. Involved in the manufacture of lignin (cell walls). Involved in grain production.

Chlorine

Chlorine is necessary for osmosis and ionic balance; it also plays a role in photosynthesis.

Iron

Iron is necessary for photosynthesis and is present as an enzyme cofactor in plants. Iron deficiency can result in interveinal chlorosis and necrosis.

Manganese

Manganese is necessary for building the chloroplasts. Manganese deficiency may result in coloration abnormalities, such as discolored spots on the foliage.

Molybdenum

Molybdenum is a cofactor to enzymes important in building amino acids.

Nickel

In higher plants, Nickel is essential for activation of urease, an enzyme involved with nitrogen metabolismthat is required to process urea. Without Nickel, toxic levels of urea accumulate, leading to the formation of necrotic lesions. In lower plants, Nickel activates several enzymes involved in a variety of processes, and can substitute for Zinc and Iron as a cofactor in some enzymes.

Sodium

Sodium is involved in the regeneration of phosphoenolpyruvate in CAM and C4 plants. It can also substitute for potassium in some circumstances.

Zinc

Zinc is required in a large number of enzymes and plays an essential role in DNA transcription. A typical symptom of zinc deficiency is the stunted growth of leaves, commonly known as "little leaf" and is caused by the oxidative degradation of the growth hormone auxin.

Processes

Plants uptake essential elements from the soil through their roots and from the air (mainly consisting of nitrogen and oxygen) through their leaves. Green plants obtain their carbohydrate supply from the carbon dioxide in the air by the process of photosynthesis.Carbon and oxygen are absorbed from the air, while other nutrients are absorbed from the soil. .Nutrient uptake in the soil is achieved by cation exchange, wherein root hairs pump hydrogen ions (H^+) into the soil through proton pumps. These hydrogen ions displace cations attached to negatively charged soil particles so that the cations are available for uptake by the root. In the leaves, stomata open to take in carbon dioxide and expel oxygen. The carbon dioxide molecules are used as the carbon source in photosynthesis.

Although nitrogen is plentiful in the Earth's atmosphere, very few plants can use this directly. Most plants therefore require nitrogen compounds to be present in the soil in which they grow. This is made possible by largely inert atmospheric nitrogen being changed in a nitrogen fixation process to biologically usable forms in the soil by bacteria.

Plant nutrition is a difficult subject to understand completely, partially because of the variation between different plants and even between different species or individuals of a given clone. Elements present at low levels may cause deficiency symptoms, and toxicity is possible at levels that are too high. Furthermore, deficiency of one element may present as symptoms of toxicity from another element, and vice-versa.

Chapter 12

Infectious diseases

Infectious diseases

One way of proving that a given disease is "infectious", is to satisfy Koch's postulates (first proposed by Robert Koch), which demands that the infectious agent be identified only in patients and not in healthy controls, and that patients who contract the agent also develop the disease. These postulates were first used in the discovery that Mycobacteria species cause tuberculosis. Koch's postulates can not be applied ethically for many human diseases because they require experimental infection of a healthy individual with a pathogen produced as a pure culture. Often, even diseases that are quite clearly infectious do not meet the infectious criteria. For example,Treponema pallidum, the causative spirochete of syphilis, cannot be cultured in vitro - however the organism can be cultured in rabbittestes. It is less clear that a pure culture comes from an animal source serving as host than it is when derived from microbes derived from plate culture. Epidemiology is another important tool used to study disease in a population. For infectious diseases it helps to determine if a disease outbreak is sporadic (occasional occurrence), endemic (regular cases often occurring in a region), epidemic (an unusually high number of cases in a region), or pandemic (a global epidemic).

Contagiousness

Infectious diseases are sometimes called "contagious disease" when they are easily transmitted by contact with an ill person or their secretions (e.g., influenza). Thus, a contagious disease is a subset of infectious disease that is especially infective or easily transmitted. Other types of infectious/transmissible/communicable diseases with more specialized routes of infection, such as vector transmission or sexual transmission, are usually not regarded as "contagious," and often do not require medical isolation (sometimes loosely called quarantine) of victims. However, this specialized connotation of the word "contagious" and "contagious disease" (easy transmissibility) is not always respected in popular use.

By anatomic location

Infections can be classified by the anatomic location or organ system that is infected, including:

- Urinary tract infection
- Skin infection
- Respiratory tract infection

- Odontogenic infection (an infection that originates within a tooth or in the closely surrounding tissues)
- Vaginal infections
- Intra-amniotic infection

In addition, locations of inflammation where infection is the most common cause include pneumonia, meningitis and salpingitis.

Signs and symptoms

The symptoms of an infection depend on the type of disease. Some signs of infection affect the whole body generally, such as fatigue, loss of appetite, weight loss, fevers, night sweats, chills, aches and pains. Others are specific to individual body parts, such as skin rashes, coughing, or a runny nose.

In certain cases, infectious diseases may be asymptomatic for much or even all of their course in a given host. In the latter case, the disease may only be defined as a "disease" (which by definition means an illness) in hosts who secondarily become ill after contact with an asymptomatic carrier. An infection is not synonymous with an infectious disease, as some infections do not cause illness in a host.

Bacterial or viral

Bacterial and viral infections can both cause the same kinds of symptoms. It can be difficult to distinguish which is the cause of a specific infection. It's important to distinguish, because viral infections cannot be cured by antibiotics.

Comparison of viral and bacterial infection

Characteristic Viral infection

Comparison of viral and bacterial infection

Characteristic	Viral infection	Bacterial infection
Typical symptoms	In general, viral infections are systemic. This means they involve many different	The classic symptoms of a bacterial infection are localized redness, heat,

	parts of the body or more than one body system at the same time; i.e. a runny nose, sinus congestion, cough, body aches etc. They can be local at times as in viral conjunctivitis or "pink eye" and herpes. Only a few viral infections are painful, like herpes. The pain of viral infections is often described as itchy or burning.	swelling and pain. One of the hallmarks of a bacterial infection is local pain, pain that is in a specific part of the body. For example, if a cut occurs and is infected with bacteria, pain occurs at the site of the infection. Bacterial throat pain is often characterized by more pain on one side of the throat. An ear infection is more likely to be diagnosed as bacterial if the pain occurs in only one ear. A cut that produces pus and milky-colored liquid is most likely infected.
Cause	Pathogenic viruses	Pathogenic bacteria

Pathophysiology

There is a general chain of events that applies to infections. For infections to occur, a given chain of events must occur. The chain of events involves several steps—which include the infectious agent, reservoir, entering a susceptible host, exit and transmission to new hosts. Each of the links must be present in a chronological order for an infection to develop. Understanding these steps helps health care workers target the infection and prevent it from occurring in the first place.

Colonization

Infection begins when an organism successfully colonizes by entering the body, growing and multiplying. Most humans are not easily infected. Those who are weak, sick, malnourished, have cancer or are diabetic have increased susceptibility to chronic or persistent infections. Individuals who have a suppressed immune system are particularly susceptible to opportunistic infections. Entrance to the host generally occurs through the mucosa in orifices like the oral cavity, nose, eyes, genitalia, anus, or open wounds. While a few organisms can grow at the initial site of entry,

many migrate and cause systemic infection in different organs. Some pathogens grow within the host cells (intracellular) whereas others grow freely in bodily fluids.

Wound colonization refers to nonreplicating microorganisms within the wound, while in infected wounds, replicating organisms exist and tissue is injured. All multicellular organisms are colonized to some degree by extrinsic organisms, and the vast majority of these exist in either a mutualistic or commensal relationship with the host. An example of the former is the anaerobic bacteria species, which colonizes the mammalian colon, and an example of the latter is various species of staphylococcus that exist on human skin. Neither of these colonizations are considered infections. The difference between an infection and a colonization is often only a matter of circumstance. Non-pathogenic organisms can become pathogenic given specific conditions, and even the most virulent organism requires certain circumstances to cause a compromising infection. Some colonizing bacteria, such as Corynebacteria sp. and viridans streptococci, prevent the adhesion and colonization of pathogenic bacteria and thus have a symbiotic relationship with the host, preventing infection and speeding wound healing.

The variables involved in the outcome of a host becoming inoculated by a pathogen and the ultimate outcome include:

- the route of entry of the pathogen and the access to host regions that it gains
- the intrinsic virulence of the particular organism
- the quantity or load of the initial inoculant
- the immune status of the host being colonized

As an example, the staphylococcus species remains harmless on the skin, but, when present in a normally sterile space, such as in the capsule of a joint or the peritoneum, multiplies without resistance and creates a burden on the host.

It can be difficult to know which chronic wounds are infected. Despite the huge number of wounds seen in clinical practice, there are limited quality data for evaluated symptoms and signs. A review of chronic wounds in the Journal of the American Medical Association's "Rational Clinical Examination Series" quantified the importance of increased pain as an indicator of infection. The review showed that the most useful finding is an increase in the level of pain [likelihood ratio (LR) range, 11-20 makes infection much more likely, but the absence of pain (negative likelihood ratio range, 0.64-0.88) does not rule out infection (summary LR 0.64-0.88).

Disease

Disease can arise if the host's protective immune mechanisms are compromised and the organism inflicts damage on the host.Microrganisms can cause tissue damage by releasing a variety of toxins or destructive enzymes. For example, Clostridium tetanireleases a toxin that paralyzes muscles, and staphylococcus releases toxins that produce shock and sepsis. Not all infectious agents cause disease in all hosts. For example less than 5% of individuals infected with polio develop disease. On the other hand, some infectious agents are highly virulent. The prion causing mad cow disease and Creutzfeldt–Jakob disease kills almost all animals and people that are infected.

Persistent infections occur because the body is unable to clear the organism after the initial infection. Persistent infections are characterized by the continual presence of the infectious organism, often as latent infection with occasional recurrent relapses of active infection. There are some viruses that can maintain a persistent infection by infecting different cells of the body. Some viruses once acquired never leave the body. A typical example is the herpes virus, which tends to hide in nerves and become reactivated when specific circumstances arise.

Persistent infections cause millions of deaths globally each year. Chronic infections by parasites account for a high morbidity and mortality in many underdeveloped countries.

Transmission

For infecting organisms to survive and repeat the infection cycle in other hosts, they (or their progeny) must leave an existing reservoir and cause infection elsewhere. Infection transmission can take place via many potential routes:

- Droplet contact, also known as the respiratory route, and the resultant infection can be termed airborne disease. If an infected person coughs or sneezes on another person the microorganisms, suspended in warm, moist droplets, may enter the body through the nose, mouth or eye surfaces.
- Fecal-oral transmission, wherein foodstuffs or water become contaminated (by people not washing their hands before preparing food, or untreated sewage being released into a drinking water supply) and the people who eat and drink them become infected. Common fecal-oral transmitted pathogens include Vibrio cholerae, Giardia species, rotaviruses, Entameba histolytica, Escherichia coli, and tape worms. Most of these pathogens cause gastroenteritis.
- Sexual transmission, with the resulting disease being called sexually transmitted disease

- Oral transmission; Diseases that are transmitted primarily by oral means may be caught through direct oral contact such askissing, or by indirect contact such as by sharing a drinking glass or a cigarette.
- Transmission by direct contact; Some diseases that are transmissible by direct contact include athlete's foot, impetigo and warts
- Vertical transmission'; directly from the mother to an embryo, fetus or baby during pregnancy or childbirth. It can occur when the mother gets an infection as an intercurrent disease in pregnancy.
- Iatrogenic transmission, due to medical procedures such as injection or transplantation of infected material.
- Vector-borne transmission, transmitted by a vector, which is an organism that does not cause disease itself but that transmits infection by conveying pathogens from one host to another.

The relationship between virulence versus transmissibility is complex; if a disease is rapidly fatal, the host may die before the microbe can get passed along to another host.

Prevention

Techniques like hand washing, wearing gowns, and wearing face masks can help prevent infections from being passed from the surgeon to the patient or vice versa. Frequent hand washingremains the most important defense against the spread of unwanted organisms. Nutrition must be improved and one has to make changes in life style- such as avoiding the use of illicit drugs, using a condom, and entering an exercise program. Cooking foods well and avoiding foods that have been left outside for a long time is also important.

Antimicrobial substances used to prevent transmission of infections include:

- antiseptics, which are applied to living tissue/skin
- disinfectants, which destroy microorganisms found on non-living objects.
- antibiotics, called prophylactic when given as prevention rather as treatment of infection.

However, long term use of antibiotics leads to resistance and chances of developingopportunistic infections like clostridium difficile colitis. Thus, avoiding using antibiotics longer than necessary helps preventing such infectious diseases.

One of the ways to prevent or slow down the transmission of infectious diseases is to recognize the different characteristics of various diseases. Some critical disease characteristics that should

be evaluated include virulence, distance traveled by victims, and level of contagiousness. The human strains of Ebola virus, for example, incapacitate their victims extremely quickly and kill them soon after. As a result, the victims of this disease do not have the opportunity to travel very far from the initial infection zone. Also, this virus must spread through skin lesions or permeable membranes such as the eye. Thus, the initial stage of Ebola is not very contagious since its victims experience only internal hemorrhaging. As a result of the above features, the spread of Ebola is very rapid and usually stays within a relatively confined geographical area. In contrast, the Human Immunodeficiency Virus (HIV) kills its victims very slowly by attacking their immune system. As a result, many of its victims transmit the virus to other individuals before even realizing that they are carrying the disease. Also, the relatively low virulence allows its victims to travel long distances, increasing the likelihood of anepidemic.

Another effective way to decrease the transmission rate of infectious diseases is to recognize the effects of small-world networks. In epidemics, there are often extensive interactions within hubs or groups of infected individuals and other interactions within discrete hubs of susceptible individuals. Despite the low interaction between discrete hubs, the disease can jump to and spread in a susceptible hub via a single or few interactions with an infected hub. Thus, infection rates in small-world networks can be reduced somewhat if interactions between individuals within infected hubs are eliminated (Figure 1). However, infection rates can be drastically reduced if the main focus is on the prevention of transmission jumps between hubs. The use of needle exchange programs in areas with a high density of drug users with HIV is an example of the successful implementation of this treatment method. Another example is the use of ring culling or vaccination of potentially susceptible livestock in adjacent farms to prevent the spread of the foot-and-mouth virus in 2001.

A general method to prevent transmission of vector-borne pathogens is pest control.

Immunity

Infection with most pathogens does not result in death of the host and the offending organism is ultimately cleared after the symptoms of the disease have waned.[4] This process requires immune mechanisms to kill or inactivate the inoculum of the pathogen. Specific acquired immunity against infectious diseases may be mediated by antibodiesand/or T lymphocytes. Immunity mediated by these two factors may be manifested by:

- a direct effect upon a pathogen, such as antibody-initiated complement-dependent bacteriolysis, opsonoization, phagocytosis and killing, as occurs for some bacteria,
- neutralization of viruses so that these organisms cannot enter cells,
- or by T lymphocytes which will kill a cell parasitized by a microorganism.

The immune system response to a microorganism often causes symptoms such as a highfever and inflammation, and has the potential to be more devastating than direct damage caused by a microbe.

Resistance to infection (immunity) may be acquired following a disease, by asymptomatic carriage of the pathogen, by harboring an organism with a similar structure (crossreacting), or by vaccination. Knowledge of the protective antigens and specific acquired host immune factors is more complete for primary pathogens than for opportunistic pathogens.

Immune resistance to an infectious disease requires a critical level of either antigen-specific antibodies and/or T cells when the host encounters the pathogen. Some individuals develop natural serum antibodies to the surface polysaccharides of some agents although they have had little or no contact with the agent, these natural antibodies confer specific protection to adults and are passively transmitted to newborns.

Host genetic factors

The clearance of the pathogens, either treatment-induced or spontaneous, it can be influenced by the genetic variants carried by the individual patients. For instance, for genotype 1 hepatitis C treated with Pegylated interferon-alpha-2a or Pegylated interferon-alpha-2b(brand names Pegasys or PEG-Intron) combined with ribavirin, it has been shown that genetic polymorphisms near the human IL28B gene, encoding interferon lambda 3, are associated with significant differences in the treatment-induced clearance of the virus. This finding, originally reported in Nature, showed that genotype 1 hepatitis C patients carrying certain genetic variant alleles near the IL28B gene are more possibly to achieve sustained virological response after the treatment than others. Later report from Nature demonstrated that the same genetic variants are also associated with the natural clearance of the genotype 1 hepatitis C virus.

Diagnosis

Diagnosis of infectious disease sometimes involves identifying an infectious agent either directly or indirectly. In practice most minor infectious diseases such as warts, cutaneous abscesses, respiratory system infections and diarrheal diseases are diagnosed by their clinical presentation.

Conclusions about the cause of the disease are based upon the likelihood that a patient came in contact with a particular agent, the presence of a microbe in a community, and other epidemiological considerations. Given sufficient effort, all known infectious agents can be specifically identified. The benefits of identification, however, are often greatly outweighed by the cost, as often there is no specific treatment, the cause is obvious, or the outcome of an infection is benign.

Diagnosis of infectious disease is nearly always initiated by medical history and physical examination. More detailed identification techniques involve the culture of infectious agents isolated from a patient. Culture allows identification of infectious organisms by examining their microscopic features, by detecting the presence of substances produced by pathogens, and by directly identifying an organism by its genotype. Other techniques (such as X-rays, CAT scans, PET scans or NMR) are used to produce images of internal abnormalities resulting from the growth of an infectious agent. The images are useful in detection of, for example, a bone abscess or aspongiform encephalopathy produced by a prion.

Symptomatic diagnostics

The diagnosis is aided by the presenting symptoms in any individual with an infectious disease, yet it usually needs additional diagnostic techniques to confirm the suspicion. Some signs are specifically characteristic and indicative of a disease and are calledpathognomic signs; but these are rare.

In children the presence of cyanosis, rapid breathing, poor peripheral perfusion, or a petechial rash increases the risk of a serious infection by greater than 5 fold. Other important indicators include parental concern, clinical instinct, and temperature greater than 40 °C.

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