

Chemistry, Haematology, and Virology Laboratory Consolidation

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Introduction

The portfolio herein discusses the consolidation of three laboratories, including the chemistry, hematology, and virology laboratories of St David's University Hospital, St Martin's Hospital, and St Jude's Hospital. Consolidation of hospital laboratories can take time, but it is beneficial to all service users who will use the laboratory. Before the portfolio talks about the consolidation process, it is essential to understand chemistry, hematology, and virology.

Chemistry

Chemistry is a branch of science (physical) that deals with the study of the properties of matter and its relationship with energy (Quaroni and Zobi 2014, p. 149). The study of chemistry ranges from qualitative to quantitative approaches. Qualitative chemistry works on manufacturing new substances used in medicine, while quantitative chemistry works in physical, that is, atoms and molecules that apply at a microscopic level (Murso et al. 2017). In chemistry, a chemical is everything and everywhere. Thus, anything a person touches, sees, or smells has one chemical or the other; some are human-made (Giera et al. 2016) others occur naturally. Chemistry addresses matters like how molecules and atoms link to form new chemical compounds via chemical bonds. Four types of bond chemistry include covalent bonds, ionic bonds, hydrogen bonds, and Van der Waals force. In a covalent bond, chemical substances/compounds share one or more electrons; in ionic bonds, compounds offer their outermost one or more electrons to other compounds to produce anions and cations (ions) (Quaroni and Zobi 2014, p. 149).

Modern Principles Of Chemistry

So that NHS successfully consolidates the three hospital laboratories into one large laboratory, it is essential to understand the current principles of [master chemistry](#). The Quantum mechanical model is the modern ideal of atomic structure in chemistry (Quaroni and Zobi 2014, p. 150). Traditional chemistry begins with the study of atoms, metals, molecules, crystals, substances, and other elements of matter. Matter can be considered in solid, fluid, or gas states, segregation, or mix. The cooperation, responses, and changes that are examined in chemistry are normally the consequence of collaborations among atoms, prompting modifications of the compound bonds that hold molecules together (Dussarrat et al., 2014). Such practices are contemplated in a chemistry research center.

The chemistry lab characteristically utilizes different types of research center dish sets. However, glassware is not fundamental to chemistry, and many trials (and additionally connected/modern) chemistry are managed without it (Murso et al. 2017). Arrangements of constituents in reagent bottles, including nitric corrosive and ammonium hydroxide, lit up in various hues (Giera et al. 2016).

The transformation of some compounds or substances into one or more various compounds or elements is called a chemical reaction (Dussarrat et al., 2014). The primary activity in the chemical reaction is the rearrangement of the electrons between the atoms in chemical bonds. The chemical reaction can be symbolized by a chemical equation where the atoms are the subjects, in which case the number of atoms is equal in either the left or right part of the equation (Giera et al. 2016). However, when there is no balanced equation, the chemical reaction there is called radioactive decay or nuclear reaction. In chemistry, many concepts are studied, which include matter, atoms, elements, molecules, and compounds (Quaroni and Zobi 2014, p. 151).

In chemistry, matter is characterized as anything with volume and rest mass and is made up of substances/ particles (Xu et al. 2016). Most of the substances that create matter have rest mass, too. However, not all substances have rest mass, for example, the photon. Matter can be an unadulterated compound substance or a blend of essences. Atom, on the other hand, is a fundamental unit of chemistry (Quaroni and Zobi 2014, p. 151). It comprises a thick center called the nuclear core encompassed by a space facilitating an electron cloud. The nucleus is composed of emphatically uncharged neutrons and charged protons (together called nucleons), while the electron cloud includes adversely charged electrons that circle the nucleus. In a neutral atom, the contrarily charged electrons offset the positive charge of the protons (Dussarrat et al., 2014). The nucleus is thick; the mass of a nucleon is approximately 1,836 times that of an electron, yet the sweep of an atom is around 10,000 times that of its nucleus (Quaroni and Zobi 2014, p. 151). The atom is likewise the littlest substance that can be imagined to hold the concoction properties of the component, for example, electronegativity, ionization potential, favored oxidation state(s), coordination number, and favored sorts of bonds to shape (e.g., metallic, ionic, covalent) (Murso et al. 2017). An element is an unadulterated particle that is made out of a solitary atom, described by its specific number of protons in the nuclei of its atoms, known as the atomic number and spoken to by the letter Z (Giera et al. 2016). The mass number is the whole number of protons and neutrons in a nucleus.

Albeit every one of the nuclei of all atoms having a place with one component will have the same nuclear amount, they may not have a similar mass number; iotas of an element that have various mass numbers are known as isotopes. For instance, all particles with 6 protons in their cores are molecules of the compound component carbon, yet iotas of carbon may have mass quantities of 12 or 13 (Quaroni and Zobi 2014, p. 151).

A compound is a substance framed when at least two chemical components are bonded together chemically (Murso et al., 2017). In blends, the elements present are not bonded together chemically. The standard terminology of mixes is set by the International Union of Pure and Applied Chemistry (IUPAC) (Dussarrat et al. 2014). The personal classification system names natural combinations. The

inorganic terminology framework makes the names of Inorganic blends. At the point when a compound has more than one segment, at that point, they are isolated into two classes, the electropositive and the electronegative components. What is more, the Chemical Abstracts Service has concocted a strategy to list synthetic substances. In this plan, every synthetic element is identifiable by a number known as its CAS registry number. Lastly, a collection of atoms is reinforced together to represent a chemical compound as the smallest unit that can participate in a chemical reaction. A particle, one of the least compounds of matter, exists as a nucleus or an atom (Giera et al. 2016).

Hematology

Hematology is the science or investigation of blood, blood-forming organs and blood sicknesses (Hoffbrand 2016). In the medical or therapeutic field, hematology incorporates the treatment of blood disorders and malignancies, including kinds of hemophilia, leukemia, lymphoma, and sickle-cell sickness. Hematology is a branch of internal pharmaceuticals that arranges the physiology, pathology, etiology, finding, treatment, forecast, and aversion of blood-related clutters (Hawkey 2017). Hematologists center to a great extent around lymphatic organs and bone marrow and may analyze blood tally abnormalities or platelet anomalies. Hematologists treat organs that are bolstered by platelets, including the lymph hubs, spleen, thymus, and lymphoid tissue (Hawkey 2017).

Anatomy Of Blood

Blood is comprised of various sections, including white blood cells, red blood cells, platelets, and plasma (Bailey et al., p93). Red blood cells, which make up around 45% of whole blood, convey oxygen from the lungs to the body's tissue. They additionally carry carbon dioxide back to the lungs to be breathed out (Hoffbrand 2016). They are circles formed and manufactured in the bone marrow. White blood cells, which are additionally made in the marrow, help battle disease. Together with platelets, they make up less than 1% of whole blood. Platelets are little, dry pieces that stick together and collaborate with thickening proteins to stop or counteract bleeding (Lee et al., 2006). They are likewise made in bone marrow. Plasma is the liquid piece of the blood. Made out of 92% water, it similarly contains necessary proteins, mineral salts, sugars, fats, hormones, and vitamins (Hawkey 2017).

Area Of Study

Four noteworthy areas of research within hematology incorporate hemoglobinopathy, hematological malignancies, iron deficiency, and coagulopathy (Bailey et al., p93). Hemoglobinopathy is the investigation of variation from the norm in the globin chains of hemoglobin atoms. Notwithstanding sickle cell weakness, thalassemia (otherwise called erythropoiesis) is a piece of hemoglobinopathy

(Lee et al. 2006). The territory of hematological malignancies is worried about the conclusion and treatment of tumors of the bone marrow, blood and lymph hubs. Myeloma is one kind of hematological harm, alongside leukemia and lymphoma. Different clusters treated by a hematologist incorporate blood vessel thromboembolism, deep vein thrombosis, and neutropenia (Hawkey 2017).

Haematology Oncology

In spite of the fact that hematologists cooperate with specialists from different medicinal and surgical fortes, hematology is frequently connected with oncology (Lee et al. 2006). Hematologists and oncologists collaborate to watch over grown-ups and youngsters with tumors of the blood and bone marrow, including leukemia and lymphoma (Hawkey 2017).

Hematology Tests

A standout amongst the most well-known hematology tests is the entire blood check or CBC (Zenz et al. 2010, p. 37). This test is regularly directed amid a standard exam and can recognize paleness, clotting issues, blood growths, resistant framework issues and contaminations. Other hematology tests incorporate Blood chemistry tests, Blood enzyme tests, and blood tests to survey coronary illness hazards (Bailey et al. p93)

Virology

Epidemiologic investigations demonstrate that viral contaminations are the most widely recognized reason for a severe infection that does not require hospitalization (Mackay et al. 2002, p. 37). Viral sicknesses likewise cause a substantial toll on mortality and changeless inability, particularly among babies and youngsters (Francki et al. 2012). Rising viral infections, for example, those because of HIV, Ebola infection, and Hantavirus, show up routinely. Since anti-infection agents viably control most bacterial contaminations, viral diseases represent a more unique and less controlled danger to human well-being (Hull 2013). A few pieces of information propose that the officially vast extent of setting up viral illnesses soon might be extended to incorporate different genuine human afflictions, for example, juvenile diabetes, rheumatoid joint inflammation, different neurologic and immunologic issues, and a few tumors (Hull 2013).

Viruses can taint all types of life (bacteria, plants, protozoa, growths, creepy crawlies, angle, reptiles, fowls, and warm-blooded creatures); be that as it may, this segment covers just infections fit for causing human diseases (Mackay et al. 2002, p. 37). Like different microorganisms, viruses may have assumed a part in the standard choice of animal species. A recorded case is the usual choice of rabbits impervious to fatal myxoma infection amid a few scourges purposely prompted to control the rabbit populace in Australia. Backhanded proof proposes that smallpox infection played the same particular part in people (Hull 2013). Another conceivable, however unproven, component by which

viruses may influence advancement is by bringing viral genetic material into creature cells by systems like those that represent quality exchange by bacteriophages (Francki et al. 2012). For instance, qualities from a virulent retrovirus incorporated into genomes of chickens or mice create protection from reinfection by related, harmful retroviruses (Francki et al. 2012). A similar relationship may exist for human retroviruses since human leukemia-causing retroviruses have been reported.

Viruses are little, subcellular agents that cannot duplicate outside a host cell (intracellular, commit parasitism). The amassed virus (virion) is shaped to incorporate just a single kind of nucleic corrosive (RNA or DNA) and, in the least painful infections, a protective protein coat (Mackay et al. 2002, p. 37). The nucleic destructive contains the genetic data essential to program the engineered apparatus of the host cell for viral replication. The protein coat serves two principal capacities: to begin with, it shields the nucleic corrosive from extracellular natural put-down, for example, nucleases; second, it awards the association of the virion to the film of the host cell, the negative charge of which would rebuff a stripped nucleic destructive (Hull 2013). Once the viral genome has entered and, in this way, tainted the host cell, infection replication, for the most part, relies upon has cell apparatus for vitality and engineered prerequisites (Matthews 2012).

Although some viruses may build up a few types of noiseless contamination of cells, their augmentation, for the most part, causes cell harm or demise (Hull 2013). Since infections must rely upon survival for their survival, they tend to set up gentle diseases in which the passing of the host is more a deviation than a general result (Francki et al. 2012). Prominent exemptions are HIV, Ebola infection, hantavirus, and rabies virus. The intracellular area of the virus regularly secures it against a portion of the host's resistant systems. In the meantime, this area makes the infection defenseless as a result of its reliance on the host cell's engineered hardware, which might be modified by even simple physical and substance changes delivered by the viral contamination (aggravation, fever, circulatory modifications, and interferon) (Matthews 2012).

Viruses are troublesome focuses for chemotherapy since they repeat just inside host cells, mostly using a large number of the host cell's biosynthetic procedures. The similitude of host-coordinated and infection-coordinated procedures makes it hard to discover antiviral agents sufficiently particular to apply a more noteworthy impact on viral replication in infected cells than on capacities in uninfected host cells (Mackay et al. 2002, p. 37). It is becoming progressively evident, in any case, that every virus may have a couple of particular strides of replication that might be utilized as focuses for very specific, deliberately pointed chemotherapeutic operators. In this manner, legitimate utilization of such medications requires intensive learning of the reasonable targets, given the right analysis and accurate comprehension of the replicative components for the culpable infection (Hull 2013).

Learning of the pathogenetic components by which the virus enters, spreads inside, and exits from the body likewise are primary for amends determination and treatment of ailment and counteractive action of spread in nature (Francki et al. 2012). Powerful therapy with a counteracting agent containing immunoglobulin requires knowing when the virus is helpless to immunizer (for instance,

amid viremic spread) and when the virus achieves target organs where the neutralizer is less viable (Solomon et al. 2010, p. 778). Numerous fruitful antibodies have been founded on learning about pathogenesis and resistant barriers. Practically identical contemplations oversee treatment with interferon (Mackay et al. 2002, p. 37).

Unmistakably, viral infections are among the most troublesome and demanding issues a doctor must face (Hayes et al., 2005). Tragically, some of these issues still need palatable arrangements, albeit a colossal advance has been made amid the most recent quite a few years. Numerous parts of medicinal virology are currently comprehended, others are being illuminated step by step, and numerous more are as yet dark (Matthews 2012). Information about the properties of infections and the connections they build up with their hosts is essential to fruitful examination and clinical administration of their pathologic procedures (Solomon et al. 2010, p. 778).

Consolidation Plan Of St David's University Hospital, St Martin's Hospital, And St Jude's Hospital

Hub And Spoke Model

The hub and spoke model is an organization of links organized like a wire wheel in which all activities are done along spokes connected with the center in the middle (Liu et al. 2012, p 581). The model is utilized as a part of an industry, especially in transport, media communications, cargo, and dispersed figuring (where it is known as a star organization) (Hoffman Lambon 2011). The center point of the hub and spoke model is the display that is most often contrasted with the point-to-point travel demonstrators (James and Truman 2015). The healthcare industry hub and spoke model is defined as having many healthcare practice sites where the center is the main site, and the spoke is other sections are connected to the primary site, and both deliver the same specialty (Hoffman Lambon 2011).

Report Of The Review Of NHS Pathology Services In England

The survey of pathology services in England that was led by Lord Carter of Coles plots how pathology exercises are kept running in the United Kingdom. The report characterized pathology as the administration that gives learning and analytic data to the instance of patients individually by conducting the scientific investigation of specific blood, tissues, liquids, and different samples. Pathology administrations is set up as a fundamental component of clinical administrations through the commitment they make to the compelling counteractive determination, recognition,

administration and treatment of infection, particularly perpetual illness. The pathology administrations work intimately with the Health Protection Agency in the investigation of irresistible diseases and in the arrangement of pro-demonstrative administrations. Pathologists additionally give post-mortem and mortuary administrations. In this nation (not at all like some different nations), the pathology administrations are not in charge of the arrangement of blood despite the fact that they march and issue blood and utilize blood items. As indicated by the report, the pathology administrations have three key components. The administrations incorporate one, the pre-analytic (for instance, phlebotomy, coordination, counsel on proper tests, and generation of clinical rules). Two, the analytic and the post-analytic (for instance, understanding and spread of outcomes to clients, an arrangement of further proper examinations and guidance on the finding and treatment of patients). In these territories, they assume a crucial part in conveying clinical administration (through for instance, clinical audit). They additionally take an interest in preparing, educating, and looking into, incorporating with other social insurance experts, and give help administration to the director of clinical trials.

In the UK, pathology is a specialist clinical administration. Experts might be qualified in drug or clinical science, for example, clinical organic chemistry, immunology, or microbiology.

Widespreadrangedcrowds are hired in pathology: notwithstanding medical pathologists, there are clinical researchers, biomedical researchers, specialized medicinal officers, therapeutic lab associates, phlebotomists, and regulatory and administrative operatives. The pathology personnel – assessed at around 25,000 individuals (entire period reciprocals) – is shrouded in detail somewhere else in the report. Pathology is comprised of various diverse clinical fortes that include hematology, histopathology, cytology, clinical biochemistry (likewise alluded to as cell pathology), immunology, microbiology and virology. Phlebotomy is the accumulation of blood tests from sick persons.

The report likewise examined vital drivers of change in pathology, and they include: One, the service should be produced to live up to individuals' changing desires as too brilliant, protected and proficient therapeutic services administrations, conveyed nearer to home. Two, the administration should be overhauled and streamlined around individuals and the principal clients' prerequisites for examinations pathology. Three, the administration has to grasp aggressiveness and the majority of arrangements and a commissioner-led focus. Four, the administration requires substantial nearby clinical initiative and commercial angle administration foundation. Five, the administration needs to center on profitability by coordinating the employee's movement and work process, as well as the parts and capacities that are expected to convey it, through enhancing frameworks and forms and understanding the advantages of innovation with quicker appropriation.

Barriers To Change

The report additionally laid out the barriers to change. Pathology service directors should have the capacity to control the significant determinants of administration quality and productivity. The report recognized various elements which obstruct the conveyance of a proficient and viable administration.

They comprise One, the absence of IT day-to-day activities availability in pathology, which confines the chance to convey successful order decisions communications help (both of which would limit wrong or superfluous rehash testing) and also to meet extra, but essential clinical and administration needs.

Second, the discontinuity of test accumulation administrations constrains the open door for conveying a proficient patient-centered administration and also everyday pathology service administration. Third, among officials, the absence of comprehension about the tests accessible prompts problematic and infrequently unseemly utilization. Fourth, for laboratory services, the debased nature of logistical support (particularly the transport of tests) and the effect this has on the productivity of the administration. Five, the way that the administration of the pathology services, mainly monetary, is excessively impacted by the needs and budgetary strength of the host trust. Other barriers include logistic/transport support, a variability of test repertoire, an inconsistency of configuration, complex workforce/skill mix, lack of investment, and separate point of care testing.

Priorities For Change

The report gave priorities for change in the pathology field, which include: One, the advancement of a national plan or specification as a reason for enhancing quality, both in connection to the conveyance of the pathology benefit itself and the more powerful utilization of the administration in the more magnificent setting of the patient trip. Clear execution measures for the conveyance of the administration ought to be produced to guarantee the successful utilization of the pathology service. Second, the formation of stand-alone pathology administration suppliers would empower officials to center around what is obligatory for homegrown economic well-being. The idea could be connected to an all the more thoroughly broadly characterized duty. Third, everyday IT network in pathology to empower, arrange interchanges, and choice help to be set up widely over the distinctive well-being supplier divisions and to help different requests on pathology, for example, wellbeing assurance, illness observation and the administration of long-haul conditions and interminable ailment. Other priorities include national reimbursement/tariff, large-scale workforce change – multi-disciplinary working and strong clinical leadership and management skills.

Workforce

As the report traces, the pathology workforce of around 25,000 individuals at present comprises some unique experts and business bunches who work in five essential orders or specialties. The experts incorporate restoratively qualified pathologists who give guidance, translate results, and direct patient care, having an enrollment in the Royal College of Pathologists and being enlisted with the General Medical Council. Two, clinical researchers who give guidance, translation, and progressed logical aptitude more often than not have the participation of the Royal College of Pathologists and are enlisted with the Health Professions Council.

Three, Biomedical researchers who give the center of the benchwork related to pathology and are enrolled with the Health Professions Council. Fourth, Medical specialized officers who give a more elevated amount of specific help and incorporate, as an unmistakable gathering, anatomical pathology technologists. Fifth, cervical cytology screeners give specialized help to the national growth screening program cervical cytology program. Seven phlebotomists attempt venepuncture and, in a few regions, other hematology examinations or purpose-of-mind testing. Finally, authoritative and administrative staff who directly manage and give an extensive variety of supporting parts.

Laboratory Services

The laboratory services include clinical treatment, diagnosis, health protection, infection control, outbreak investigation, surveillance reporting, samples for reference testing, near-patient testing, communication and IT, standards and SOPs, safety and biosecurity, and accreditation.

Report Of The Second Phase Of The Independent Review Of NHS Pathology Services

The second review of the NHA Pathology Services by Lord Carter of Coles and his committee gave some recommendations on the consolidation of the three hospitals to improve pathology services in England. The committee found out that alliance was the best approach to enhance the pathology services to the citizens. The board dispatched some displays of pathology administrations given data from two SHAs. The models expected that merged, reconfigured administrations – systems – would have the accompanying highlights to profit by the economies of scale. One is obligation regarding all the services benefit of a deciphered outcome, including transport and coordination. Two, full Information Technology availability to interface the client (regardless of whether essential or optional) mind with the research facility. It was accepted that no lessening popular (or request development) would take after. As of now, the neglected need would offset wrong or pointless cases. Three, compelling and temperate administration of assets, for instance, individuals and hardware, by the best practice, for example, call, expertise blend, and efficiency.

The report had some assumptions that included one, despite the fact that solidification of pathology administrations should empower numerous NHS trusts to excuse their destinations; for instance, some pathology would get off-site or lessen in scale. The benefit of liberating space nearby and any related funds would be hard to gauge and are, in this way, excluded in the modeling work (such investment funds are added to the report's evaluations of the advantages spilling out of the administration combination). Two, in effect gear, would be composed entirely off, with new systems securing all their hardware anew by a professionally created, institutionalized stock. The suspicion would encourage the institutionalization of test collections and ID, expository philosophy, and reference ranges. Along these lines, it would likewise guarantee compatibility with the new systems and empower suppliers to profit from the most recent innovation.

Service Consolidation

The report focuses on benefit mergers that incorporate one; the smaller the number of combined systems, the higher the level of investment funds. Two, a few variables will decide the correct way to deal with a union. In many parts of the nation, for instance, there are characteristic “systems” that reflect “understanding streams” – at the end of the day, the verifiable example of referrals of individuals from essential to optional and tertiary care and between auxiliary care suppliers in the NHS. The council sees these systems as the center building that hinders a transformed pathology benefit. The number will shift starting with one SHA and then onto the next, reflecting elements; for example, populace thickness and system limits may cross SHA limits. These pathology systems would incorporate available and advantageous areas where clients of the administration could give tests to a case, in polyclinics, wellbeing focuses or on the High Street. They would likewise incorporate offices for earnest testing and, as fitting, for the purpose of mind testing. The board additionally prescribed that each integrated system ought to have a clinical chief in charge of value and clinical administration and a business executive with obligations regarding legally binding and different business game plans. They would give explicit authority and responsibility to every one of the systems inside the solidified administration.

The NHS Plan

According to NHS England National Pathology Programme, NHS has plans to recruit more staff who are professionals, and they will be paid better, hence reducing waiting times for patients. When there is enough staff, the time taken to work on patients will improve. Therefore, patients will not wait for long before they are helped. NHS has plans to develop the local hospitals by bringing extra beds, doctors, and nurses and also letting the local hospital run their internal affairs, but the National Standards & Regular Inspections (CHI) will inspect the hospitals regularly. The National Institute for Clinical Excellence will be launched to provide extra training and education to healthcare professionals (Graham 2008). There will be a Modernisation Agency that oversees and modernizes healthcare practices, hence spreading the best healthcare practices. NHS and social services will come together, and patients will have a voice in healthcare. Also, healthcare professionals will extend their roles to produce better services.

Conclusion

Consolidation of hospitals’ laboratories to work under one hub is a great idea and has some benefits. After a merger, a lot of money can be saved (James and Truman, 2015). The report estimated that there would be 10 and 20 percent savings. The report further says that consolidation would result in savings of between 250 and 500 million pounds, looking at the 2005 figures (Department of Health, 2015, p. 39). Consolidation may result in the efficient use of resources, and the resources can serve

many people (James and Truman, 2015). Spokes are easy to create, which implies that alliances can allow the development of more hospitals that will depend on the hub laboratory. The model is brought together. Accordingly, everyday activities of the research facilities might be generally firm, and changes at the center point, even in a solitary course, may have unforeseen results all throughout the system. It can be hard or even far-fetched to deal with infrequent times of appeal between two spokes. If consolidations of the hospitals have some disadvantages, it is a good idea, and the ministry of NHS should take into consideration the reviews of the committee on consolidation.

References

Bailey, K., Burt, R. and Fielding, A.K., 2018. The Future of Haematology: The Impact of Molecular Biology and Gene Therapy. ABC of Clinical Haematology, p.93.

David Jamesn, and Derek Truman., 2015.Improvement in laboratory test turnaround times for inpatients following move to hub and spoke model of delivery. Southwest Pathology Service, Lisieux Way, Taunton TA1 2LB, UK.

Department of Health.Report of the Review of NHS Pathology Services in England.Chair, Lord Carter of Coles.□http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4137606 [accessed January 2015].

Department of Health.Report of the Second Phase of the Review of NHS Pathology Services in England.Chair, Lord Carter of Coles.□http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_091985 [accessed January 2015].

Dussarrat, C., Blasco, N., Pinchart, A. and Lachaud, C., Air Liquide SA, 2014. *Method of forming dielectric films, new precursors and their use in semiconductor manufacturing*.U.S. Patent 8,668,957.

Francki, R.I.B., Fauquet, C.M., Knudson, D.L. and Brown, F. eds., 2012.*Classification and Nomenclature of Viruses: Fifth Report of the International Committee on Taxonomy of Viruses. Virology Division of the International Union of Microbiological Societies* (Vol.2). Springer Science & Business Media.

Giera, A., Manecki, M., Borkiewicz, O., Zelek, S., Rakovan, J., Bajda, T. and Marchlewski, T., 2016, April.Monoclinic structure of hydroxylpyromorphite Pb₁₀ (PO₄)₆ (OH) 2-hydroxylmimetite Pb₁₀ (AsO₄)₆ (OH) 2 solid solution series. In *EGU General Assembly Conference Abstracts* (Vol. 18, p. 8312).

Graham H Beastall., 2008Department of Clinical Biochemistry. The Modernisation of Pathology and Laboratory Medicine in the UK: Networking into the Future, Royal Infirmary, Glasgow G4 0SF, UK.

Hawkey, C.M., 2017. *Comparative mammalian hematology: cellular components and blood*

coagulation of captive wild animals. Butterworth-Heinemann.

Hayes, E.B., Sejvar, J.J., Zaki, S.R., Lanciotti, R.S., Bode, A.V. and Campbell, G.L., 2005. Virology, pathology, and clinical manifestations of West Nile virus disease. *Emerging infectious diseases*, 11(8), p.1174.

Hoffbrand, A.V., 2016. *Postgraduate hematology*. John Wiley & Sons.

Hoffman, P. and Lambon Ralph, M.A., 2011. Reverse concreteness effects are not a typical feature of semantic dementia: evidence for the hub-and-spoke model of conceptual representation. *Cerebral Cortex*, 21(9), pp.2103-2112.

Hull, R., 2013. *Plant virology*. Academic Press.

Lee, S.C., Ng, S.S., Oldenburg, J., Chong, P.Y., Rost, S., Guo, J.Y., Yap, H.L., Rankin, S.C., Khor, H.B., Yeo, T.C. and Ng, K.S., 2006. Interethnic variability of warfarin maintenance requirement is explained by VKORC1 genotype in an Asian population. *Clinical Pharmacology & Therapeutics*, 79(3), pp.197-205.

Liu, S., Kasturiratne, D. and Moizer, J., 2012. A hub-and-spoke model for multi-dimensional integration of green marketing and sustainable supply chain management. *Industrial Marketing Management*, 41(4), pp.581-588.

Mackay, I.M., Arden, K.E. and Nitsche, A., 2002. Real-time PCR in virology. *Nucleic acids research*, 30(6), pp.1292-1305.

Matthews, R.C., 2012. *Plant virology*. Elsevier.

Murso, A., Kurth, C. and Rittmeyer, P., Chemetall GmbH, 2017. *Method for manufacturing magnesium amides*. U.S. Patent 9,688,632.

NHS England National Pathology Programme Skipton House, 80 London Road, London, SE1 6LH. <http://www.england.nhs.uk/ourwork/qual-clin-lead/npp/>

Quaroni, L. and Zobi, F., 2014. Cellular Imaging with Metal Carbonyl Complexes. *Inorganic Chemical Biology*, pp.149-182.

Solomon, T., Lewthwaite, P., Perera, D., Cardoso, M.J., McMinn, P. and Ooi, M.H., 2010. Virology, epidemiology, pathogenesis, and control of enterovirus 71. *The Lancet Infectious Diseases*, 10(11), pp.778-790.

Xu, W., Mu, B. and Wang, A., 2016. Facile fabrication of well-defined microtubular carbonized kapok fiber/NiO composites as electrode material for supercapacitor. *Electrochimica Acta*, 194, pp.84-94.

Zenz, T., Mertens, D., Küppers, R., Döhner, H. and Stilgenbauer, S., 2010. From pathogenesis to treatment of chronic lymphocytic leukaemia. *Nature Reviews Cancer*, 10(1), p.37.