

Medical History

# Sir Sheldon Francis Dudley, his Contributions to Diphtheria and the Aftermath of the Sinking of *HMS Curacao* by the *Queen Mary*

John Hedley-Whyte, Debra R. Milamed.

Accepted: 12<sup>th</sup> June 2017

Provenance: internally peer-reviewed

**Key Words:** WWII, Shipwrecks, Infectious disease, Diphtheria

## INTRODUCTION

Off Londonderry, the *Queen Mary*, of over 81,237 gross tons, collided at a speed of 28 knots (33.5 mph) with the Royal Navy's anti-aircraft cruiser *Curacao*. The cruiser was sliced in two at 2:20 p.m. on Friday, 2 October 1942. Both halves sank within two to five minutes.

Twenty-seven RN officers and 412 ratings were aboard the two halves of *Curacao*; 338 men perished (Fig. 1).<sup>1,2</sup> Of the 918 crew and 10,230 U.S. GIs on board the *Queen Mary*, none were hurt. As per orders the *Queen Mary* continued at twelve, then twenty knots for Greenock<sup>1</sup>. There, the U.S. 29<sup>th</sup> Infantry Division troops entrained for the South of England, with photographs of the sinking of the Belfast-based *HMS Curacao*<sup>1</sup>.

The bows of the *Queen Mary* that cut through the *Curacao* and 20 feet of her stem were repaired in a dry dock in Boston, Massachusetts from 14 October to 2 November 1942<sup>3</sup>.

## RESCUE

The RN destroyers *Bramham*, *Cowdray* and *Skate* arrived 2 hours after the incident at around 4:20 p.m. to reach the 101

survivors – two were badly injured. Sea temperature was 13-16°C<sup>4</sup>. A “Most Secret” signal was sent to the Admiralty from Ballykelly: “*Curacao* sunk 55.50 N 08.56W. Survivors including Captain picked up by two destroyers returning Londonderry...”<sup>1</sup>.

Lieutenant-Commander Baines, Commanding Officer of the *Bramham* and his First Lieutenant, David Mountbatten, Marquess of Milford Haven expertly controlled the rescue operations with loudhailers. Black tar oil was widespread and hazardous<sup>1</sup>.

## ADMIRALTY CONTROL

From the time that *Bramham* and *Cowdray* set off with the 101 survivors of the *Curacao*, the Admiralty imposed strict secrecy<sup>5,6,7</sup>.

Upon arrival at Londonderry, the 101 survivors were confined in Church premises with curtains drawn and lights on all that Friday night<sup>7</sup>. The Admiralty, with the tacit acceptance of Vice Admiral Sir Sheldon Francis Dudley, newly knighted and appointed Head of RN Medical Services, empaneled a Secret Court of Enquiry for Sunday, October 4, 1942 on board the *HMS Argus* anchored at Gourock in the Clyde<sup>1</sup>. The RN destroyer *Saladin* transported the survivors from Lough Foyle to Gourock. Survivors were then entrained in a sealed train non-stop for the 425 mile journey to Greenwich<sup>7</sup>.

By 1942, regional censorship units had been established in Belfast, Birmingham, Bristol, Cardiff, Glasgow, Leeds and Manchester. Approximately 250 active Official Censors were based in these cities and in London<sup>5</sup>. Early in 1942, Byron Price of the Associated Press led a dozen U.S. experts on censorship to the UK. The issue of a U.S. Government Code of Wartime Practices was approved as in force. The UK was classified as a U.S. War Zone. According to UK Defense (General) Regulations 1939 No. 3:



Fig 1. The Queen Mary, HMS Curacao Incident (oil on canvas), Harley Crossley (1938-2013), Bridgeman Images.

David S. Sheridan Professorship in Anaesthesia and Respiratory Therapy  
Harvard University, 1400 VFW Parkway, Boston, MA 02132-4927 USA

john\_hedley-whyte@hms.harvard.edu

Correspondence to Prof. Hedley-Whyte



UMJ is an open access publication of the Ulster Medical Society (<http://www.ums.ac.uk>).

The Ulster Medical Society grants to all users on the basis of a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International Licence the right to alter or build upon the work non-commercially, as long as the author is credited and the new creation is licensed under identical terms.

“...No person shall

1) obtain, 2) record, communicate to any other person or publish, or

3) have in his possession any document containing, or any other record whatsoever of, any information being, or purporting to be, information with respect to any of the following matters, that is to say

a) the number, description, armament, equipment, disposition, movement or condition of any of His Majesty's forces, vessels or aircraft...”<sup>5</sup>

At the War Cabinet Meeting on 9 October 1941, it had been decided to review what measures should be taken to “prevent the publication by the Press of articles likely to react unfavourably on this country's relations with foreign powers”<sup>8</sup>. Therefore a week after the sinking off Londonderry, informal discussions took place with representatives of the War Cabinet and UK and US Medical and Legal leaders. The following aspects of the Greenwich incarceration of *Curacoa's* Belfast –based ratings were considered:

Firstly, there seemed, despite two hours afloat in salt water in a 20-30 foot Atlantic swell, to be no serious physical sequelae to the survivors<sup>9</sup>. Secondly, the GI's on the *Queen Mary* had



Fig 2. Sir Sheldon Francis Dudley (1884-1956), Surgeon, Vice-Admiral and Chief of Medical Services Royal Navy. Bromide print by Walter Stoneman, 1936. From the collections of the National Portrait Gallery, London, image no. NPG 167276 . Reproduced with their permission, solely for this Medical History.

taken photos, and thirdly, the Greenwich site of incarceration had previously linked Dudley to a hostile question in the House of Commons<sup>10,11</sup> .

Dudley had been appointed Royal Navy Pathologist to Greenwich in 1921 (Fig. 2). Among his duties was “supervision of the pupils of the Royal Hospital School”<sup>10</sup>. One thousand boarders and 100 day boys stayed at the Royal Hospital School for three years of three terms per year.

Detailed medical records were maintained for each boy. “Hygienic conditions and sanitary discipline were good”<sup>10</sup>. Frequent examinations of the throat and nose included cultures. Space between dormitory beds was adequate and according to accepted standards. Incidence of “certain bacterial diseases, and particularly diphtheria, was considerable”<sup>10</sup>.

Dudley said these schoolboys were an almost ideal ‘experimental herd’. The result of this public statement led to a question in the House of Commons ‘on the ethics of making helpless schoolboys the subject of experiments’<sup>10,11</sup>.

On 23<sup>rd</sup> March 1933 the Royal Naval School was moved from its historic Greenwich buildings to Holcomb, Suffolk<sup>12</sup>.

### MEDICAL LEADERSHIP

Surgeon Vice-Admiral Sir Sheldon Francis Dudley, Medical Director-General of the Royal Navy from the summer of 1941 until the end of World War II, had qualified in 1906 from St. Thomas's Hospital before immediately joining the Royal Navy. His forbears had settled in County Tipperary during the 1620s, and his uncle was Rector of Glenarm, County Antrim<sup>10</sup>. In 1913, Dudley married Ethel Franklyn, a widow with one son. Dudley played rugby for United Hospitals and then for United Services. During World War I, Dudley served as Senior Medical Officer of the Royal Navy Air Service at Dunkirk; for this service in 1919 he was appointed OBE. In 1920 Dudley won the Liddle, London, Prize for a paper on the epidemiology of influenza<sup>10,13</sup>. In 1922 Dudley won the Gilbert Blane Medal and Neech Prize for an essay on “The Carrier Problem”<sup>14</sup>. In 1923 Dudley was appointed Professor of Pathology at the Royal Navy Medical School, Greenwich: Dudley's office was close to the Royal Hospital School, “whose thousand boys provided an ‘ideal community’ for testing his epidemiological views”, according to the *British Medical Journal*<sup>15</sup>.

Schick in 1913 described the intradermic test for susceptibility and immunity to the infectious disease caused by *B. diphtheria*<sup>16</sup>. A negative reaction indicates the presence of antitoxin. In 1922 Dudley began throat cultures and Schick tests for the 950 boys of the Royal Navy Boarding School at Greenwich. The “new” boarders were thrice as often susceptible to developing clinical diphtheria as “old” boarders. In nine months, 92 percent of the boys who developed clinical diphtheria became immune. The period of “carrying” diphtheria bacilli was always short. During seven months 30 percent of the boys were recognizable carriers (Fig. 3) (Table 1)<sup>17</sup>.

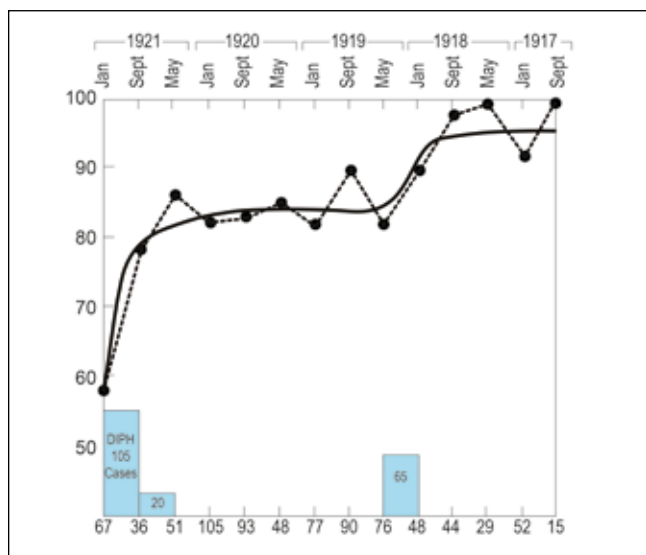


Fig 3. "831 Residential Schoolboys; Relation between number of terms in school, Schick reaction and diphtheria outbreaks. Number of boys 'new boys' out of 831 tested joining school each term.

Note: Shaded rectangles on bottom line represent character and density of diphtheric infection. The numbers associated with these rectangles include carriers of morphological diphtheria: Bacilli as well as clinical diphtheria cases." Redrawn from Dudley, 1922<sup>17</sup>.

Dudley wrote special reports for the Medical Research Council (MRC), "The Schick Test, diphtheria and scarlet fever" (1923)<sup>18</sup>, "The spread of droplet infection in semi-isolated communities" (1926)<sup>19</sup>, and "Active immunization against diphtheria: its effect on the distribution of antitoxic immunity and case and carrier infection" (1934)<sup>20</sup>. Dudley's 1931 Milroy Lecture, "Lessons on the distribution of infectious diseases in the Royal Navy", became of seminal importance in World War II<sup>21</sup>. Dudley's work led to mass X-ray screening for tuberculosis<sup>22</sup>, aided the eradication of diphtheria and was cited as justification for control and prevention of inadequate bed, bunk and hammock spacing<sup>23</sup>. For the *Queen Mary*, this reduced troop carrying capacity from 15,000 to 12,000 Allied warriors<sup>3</sup>. During World War II, Dudley chaired the Shipwreck Research Committee of the Medical Research Council<sup>24</sup>. Dudley's work on infectious disease control and vaccination resulted in much progress<sup>25</sup>.

Dudley's 1931 Milroy Lecture summarized his experience of infectious disease as then Surgeon-Captain in the Royal Navy and emphasized the longitudinal contribution of the RN's study population since 1856<sup>21</sup>. He associated transmission of infectious diseases with population density aboard ship and in training facilities. Dudley's 1921 study of epidemic influenza had described transmission of infectious disease as a function of "infectivity of the specific germ and the density, that is, the number per unit area, of people susceptible to that degree of infectivity"<sup>13</sup>. His later investigations made use of the RN's "unbroken statistical record" on cholera, cerebrospinal fever, fevers, pneumonia and other infectious diseases<sup>25,26</sup>.

TABLE 1.

*Dudley's Conclusions: Royal Hospital School Of Greenwich*

(1)	" 'New' boys were three times as often susceptible to diphtheria as 'old boys' (Fig. 3).
(2)	A graph (Fig. 3) is shown which indicates that the 'old' boys became immune during outbreaks of diphtheria, and that between outbreaks no immunity was developed.
(3)	The fact that the 'old' boys were older was insufficient to account for the more frequent immunity.
(4)	In the course of three months 32 per cent of the susceptible boys became immune.
(5)	In the course of nine months 92 per cent of the boys who developed clinical diphtheria became immune.
(6)	The period of 'carrying' diphtheria bacilli was always short, and it is estimated that during seven months 30 per cent of the boys were recognisable carriers.
(7)	Under these circumstances it is probable that all boys in the school had the opportunity of being affected by the diphtheria bacillus to a slight unrecognizable degree." <sup>17</sup>

### DEVELOPMENTS AFTER SEALED TRAIN TO GREENWICH

The Allied Surgical Consultants protested the Greenwich incarceration. The survivors of the *Curacoa* were thereupon released for a fortnight's home leave, but still sworn to secrecy<sup>7</sup>. They were then forthwith assigned to Landing Ship Tanks (LSTs) and Minesweepers: the Belfast connection with Northern Ireland therefore continued at Salerno, Normandy D-Day to the Scheldt and its V weapon bombardment<sup>27,28</sup>.

The Royal Naval Medical Services report listed 347 deaths by drowning in 1942. Since this figure was preceded by 234 reported deaths by drowning in 1941 and followed by 632 in 1943<sup>29</sup>, it remains uncertain whether some or all of the 338 *Curacoa* deaths were included.

During the World War II years, the weekly Epidemiological Notes published in the *British Medical Journal* attest to the importance of standardised reporting and, demonstrated no increase in infectious diseases in Northern Ireland<sup>30</sup>. As Medical Director-General of the RN, Dudley equated the importance of control of infectious disease and general hygiene with strategic military operations, especially outside of Western Europe, and noted that "the number killed in Bengal by preventable disease in one year was five times the 300,000 killed by high explosive in the armies of the British Empire during five years of war"<sup>25</sup>.

### A YEAR AFTER DUDLEY'S DEATH

In 1957 a Grant from the Northern Ireland Hospitals Authority supported the establishment of the Virus Reference Laboratory of the Department of Microbiology at Queen's University Belfast<sup>31,32</sup>, to provide both serological testing and virus isolation. The laboratory continued work begun



in that Department to diagnose poliomyelitis, aseptic meningitis and encephalitis, influenza (types A, B and C), psittacosis, *Rickettsia burneti*, adenoviruses and others. The work of these investigators and their colleagues led to recommendations for immunization of schoolchildren that would reinforce immunity to diphtheria, tetanus and poliomyelitis at the time of school entry, and also provide primary immunization for children with no previous immunization history<sup>33,34,35</sup>. Pertussis was subsequently added to their investigations of a quadruple vaccine for infants<sup>35</sup>.

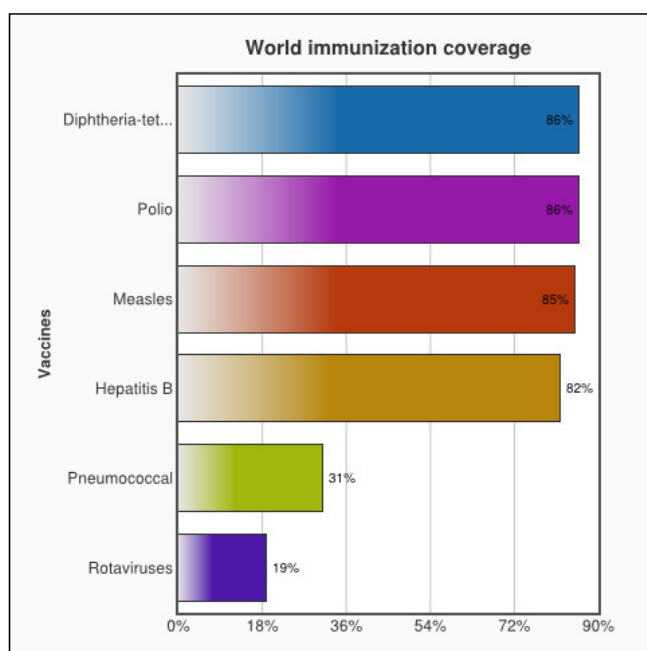


Fig 4. World Health Organization (WHO) immunization data, 2015<sup>36</sup>

According to the World Health Organization (WHO), immunization currently prevents two to three million deaths each year from diphtheria, tetanus, pertussis and measles, but improved global vaccination coverage could prevent an additional 1.5 million deaths each year. While estimates of unvaccinated infants worldwide are as high as 19.4 million, in 2015 the recommended series of three doses of diphtheria-tetanus-pertussis (DTP3) was administered to approximately 86 percent of infants worldwide<sup>36</sup> (Fig. 4).

Improvements in surveillance and timely reporting of infectious disease outbreaks have both promoted ongoing vaccination campaigns for rapidly evolving pathogens

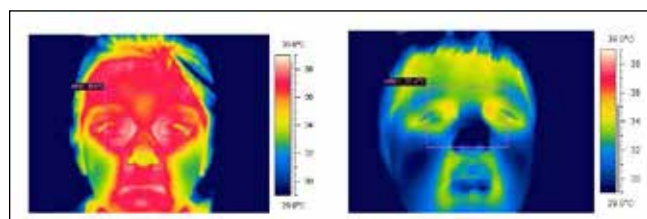


Fig 5. Thermograms of the face of a young male child. Left: during fever; right, a normal healthy child of the same age. Reproduced by permission of the authors exclusively for this Medical History<sup>45</sup>.

such as influenza viruses, and are key factors in controlling the spread of diseases for which vaccines have yet to be developed<sup>37,38,39,40,41</sup>. Training of Emergency and Primary Care Physicians and Health Care workers in requisite information transfer has played a crucial role<sup>41,42</sup>. Mass screening of travellers at international checkpoints during disease outbreaks using thermographic fever screening, questionnaires and other means may play an increasing role in global containment of emerging infectious diseases<sup>43,44,45,46</sup> (Fig. 5).

### MORE ON SECRECY

The Secrecy Order on the fate of the *Curacao* was lifted just after VJ Day. The GI-taken photos of the sinking, totally split, cruiser were available for trials in the UK's High Court, the Court of Appeal and the House of Lords<sup>1,47</sup>. The Captain of the *Queen Mary*, Cyril Illingsworth<sup>48</sup> was subsequently knighted and the Captain of the *Curacao* received the DSO for mine-sweeping in the Mediterranean<sup>49</sup>. The Marquess of Milford Haven received a DSC and OBE in 1942<sup>50</sup>. Sir Sheldon Francis Dudley had been elected FRS in 1941<sup>10</sup>.

At the end of World War II Dudley was awarded the United States Legion of Merit in 1946 on the recommendation of General Dwight Eisenhower to the U.S. Congress with the approval of President Harry S. Truman<sup>51,52</sup>. The citation was for his supervision of the Atlantic Transportation from and to the USA of their two million troops: of this two million over a quarter of a million had come to Scotland on the *Queen Mary*<sup>3</sup>.

In his later years Dudley published his views on the UK's healthcare system<sup>53</sup> and education<sup>54</sup>. Dudley died on May 6, 1956, aged 71, and was survived by his wife Ethel<sup>10</sup>.

### ACKNOWLEDGEMENTS

The authors wish to thank A.J. Blechner, Research Librarian and Library Instruction Coordinator, Aslihan A. Bulut, Librarian and Program Coordinator for Foreign, Comparative and International Law, and Meg Kribble, Research Librarian and Outreach Coordinator, of the Harvard Law School Library Reference Staff for their expert assistance. The authors wish to thank Diane Sredl, Data Reference Librarian of the Government Documents Collection, Lamont Library, Harvard University, for expert assistance. The authors wish to thank Prof. E. Francis Ring, Head of the Medical Imaging Unit, University of South Wales, and his colleagues for permission to reproduce sample screening thermographs.

### REFERENCES

1. Thomas DA, Holmes P. *Queen Mary and the cruiser: the Curacao disaster*. London; Leo Cooper; 1997. p.97, 98-129, 130-156.
2. Roskill SW. *The War at Sea 1939-1945*. Vol. II. *The period of balance*. Uckfield, East Sussex: Naval and Military Press Ltd; 2004. p.212.
3. Harding S. *Gray Ghost: The R.M.S. Queen Mary at war*. Missoula, Montana: Pictorial Histories Publishing Co.; 1982.
4. World Sea Temperatures. Europe: United Kingdom: Derry. Derry sea temperature. [Internet]. 2018. Available from: <https://www.seatemperature.org/europe/united-kingdom/derry.htm> Last accessed June 2018.



5. Wilkinson N. *Secrecy and the Media: The Official History of the United Kingdom's D-Notice System*. London: Routledge; 2009. Chapter 25, The Press and Censorship Bureau. p.169-79.
6. Propaganda policy and issue of news: correspondence culminating in formation of Press and Censorship Bureau, 1939. Located at: National Archives, Kew United Kingdom; PRO INF 1/852.
7. Wilson, EE (Oral History). Imperial War Memorial interview [Internet]. Imperial War Museum Catalog no. 16405. 1996 Jan; [audio 29.06 min.]. Available from: <http://www.iwm.org.uk/collections/item/object/80015884> Last accessed June 2018.
8. Wilkinson N. *Secrecy and the Media: The official history of the United Kingdom's D-Notice system*. London: Routledge; 2009. Chapter 26, The practice of censorship. p.180-91.
9. Modell JH. *The Pathophysiology and Treatment of Drowning and Near-drowning*. Springfield, Illinois: Charles C. Thomas; 1971.
10. Boyd JS. Sheldon Francis Dudley. 1884-1956. *Biogr Mem Fell R Soc*. 1956; **2**: 85-99. Available from: <http://rsbm.royalsocietypublishing.org/content/roybiogmem/2/85>. Last accessed June 2018.
11. Hansard 1803 – 2005. Diphtheria (Schick Test). House of Commons Debate. London: Parliament UK. House of Commons Hansard Archives. 1922 Mar 15: 151; cc 2186-7. Available from: [http://hansard.millbanksystems.com/commons/1922/mar/15/diphtheria-schick-test/#S5CV0151P0\\_19220315\\_HOC\\_217](http://hansard.millbanksystems.com/commons/1922/mar/15/diphtheria-schick-test/#S5CV0151P0_19220315_HOC_217) Last accessed June 2018.
12. Turner HD. *The Cradle of the Navy: The Story of the Royal Hospital School at Greenwich and at Holbrook, 1694-1988*. York: William Sessions Limited for the Royal Hospital School (Greenwich & Holbrook) Old Boys Association including Old Boreman Boys; 1990. p.124.
13. Dudley SF. The biology of epidemic influenza, illustrated by Naval experience. *Proc R Soc Med*. 1921; **14**(War Sect):37-50.
14. Dudley SF. High and persistent carrier rates of *Neisseria meningitidis*, unaccompanied by cases of meningitis. *J Hyg (Lond)*. 1934; **34**(4):525-41.
15. Obituary. Sir Sheldon Francis Dudley, K.C.B., O.B.E., M.D., F.R.C.P., F.R.C.S.Ed., F.R.S. *Brit Med J* 1956; **1**(4975):1113.
16. Schick B. Die Diphtherietoxin-Hautreaktion des Menschen als Vorprobe der prophylaktischen Diphtherieheilserinjektion. *Munch Med Wochenschr*. 1913; **60** (47):2608-10.
17. Dudley SF. The relation of natural diphtheria antitoxin in the blood of man to a previous infection with diphtheria bacilli. *Brit J Exp Path*. 1922; **3**(4):204-9.
18. Dudley SF. *The Schick test, diphtheria, and scarlet fever*. Medical Research Council Special Report Series no. 75. London: HMSO; 1923.
19. Dudley SF. *The spread of droplet infection in semi-isolated communities: Diphtheria*. Medical Research Council Special Report Series No. 111. London: HMSO; 1926.
20. Dudley SF, May PM, O'Flynn JA, Orr-Ewing J. *Active immunization against diphtheria*. Medical Research Council Special Report Series No. 195. London, HMSO; 1934.
21. Dudley SF. Some lessons of the distribution of infectious diseases in the Royal Navy. *Lancet*. 1931; **217**(5610):509-17.
22. Dudley SF. Pulmonary tuberculosis in the Royal Navy and the use of mass miniature radiography in its control. *Proc R Soc Med*. 1941; **34**(7):401-6.
23. Dudley SF. An address on microbic dissemination in schools. *Lancet*. 1928 Oct 27; **212**(5487):849-56.
24. Medical Research Council. Committee on the Care of Shipwrecked Personnel. *A Guide to the Preservation of Life at Sea after Shipwreck*. M.R.C. War Memorandum No. 8. London: H.M. Stationery Office; 1943.
25. Dudley S. The Royal Navy. July 1945. In: Tidy HL, Kutschbach JM, editors. *Inter-Allied Conferences on War Medicine 1942-1945, convened by the Royal Society of Medicine*. London: Staples Press; 1947. p.488-92.
26. Dudley SF. Gerontology or the problems of old age. *J R Nav Med Serv*. 1950; **36**(3):111-24.
27. Orr D, Truesdale D. *The rifles are there: 1<sup>st</sup> and 2<sup>nd</sup> battalions the Royal Ulster Rifles in the second world war*. Barnsley, South Yorkshire: Pen and Sword Military; 2005.
28. McShane M. *Neutral Shores. Ireland and the Battle of the Atlantic*. Cork: Mercier Press; 2012.
29. Ellis FP. The Royal Naval Medical Services. Table 6, Table 7, Table 8. In: Mellor WF. *Casualties and Medical Statistics*. London: HMSO; 1972. p. 31,36,41.
30. Hedley-Whyte J, Milamed DR. Battle of the Atlantic: Military and Medical Role of Northern Ireland (After Pearl Harbor). *Ulster Med J*. 2015; **84**(3):182-7.
31. Dick GW, Dane DS. The Virus Reference Laboratory. *Ulster Med J*. 1958; **27**(1):47-52.
32. Murray HG, Dane DS, Dick GW. The Virus Reference Laboratory. Department of Microbiology, The Queen's University, Belfast: report for 1957. *Ulster Med J*. 1958; **27**(1):53-60.
33. Dane DS, Dick GW, Haire M, Briggs EM, Connor TJ. A diphtheria-tetanus-poliomyelitis vaccine. *Lancet*. 1965; **1**(7391):877-9.
34. Haire M, Dane DS, Dick GW, Briggs EM, Connor TJ. Further studies with a diphtheria-tetanus-poliomyelitis vaccine. *J Hyg (Lond)*. 1966; **64**(4):485-8.
35. Dane DS, Haire M, Dick G, Briggs EM, Connor TJ. Further studies with quadruple vaccine. *J Hyg (Lond)*. 1966; **64**(4):475-84.
36. World Health Organization. News. Fact Sheets. Immunization coverage. [Internet]. Geneva: World Health Organization; 2018. Available from: <http://www.who.int/mediacentre/factsheets/fs378/en> Last accessed June 2018.
37. U.S. Centers for Disease Control and Prevention. Disease surveillance at CDC: improving disease surveillance at CDC. Atlanta, Georgia: CDC; 2017. Available from: <https://www.cdc.gov/surveillance/> Last accessed June 2018.
38. Hulth A, Andrews N, Ethelberg S, Dreesman J, Faensen D, van Pelt W, Schnitzler J. Practical usage of computer-supported outbreak detection in five European countries. *Euro Surveill*. 2010; **15**(36): pii 19658.
39. van de Venter EC, Oliver I, Stuart JM. Timeliness of epidemiological outbreak investigations in peer-reviewed European publications, January 2003 to August 2013. *Euro Surveill*. 2015; **20**(6):pii 21035.
40. Green HK, Charlett A, Moran-Gilad J, Fleming D, Durnall H, Thomas DR, et al. Harmonizing influenza primary-care surveillance in the United Kingdom: piloting two methods to assess the timing and intensity of the seasonal epidemic across several general practice-based surveillance schemes. *Epidemiol Infect*. 2015; **143**(1):1-12.
41. McConnell WW, Tohani VK. Possible method of identifying spotter practices in a health board in Northern Ireland. *Br Med J*. 1984; **288**(6415):455-7.
42. Spedding RL, Jenkins MG, O'Reilly SA. Notification of infectious diseases by junior doctors in accident and emergency departments. *J Accid Emerg Med*. 1998; **15**(2):102-4.
43. Gostic KM, Kucharski AJ, Lloyd-Smith JO. Effectiveness of traveller screening for emerging pathogens is shaped by epidemiology and natural history of infection. *eLife*. 2015; **4**: e05564. DOI:10.7554/eLife05564:116. Available from: <https://elifesciences.org/articles/05564>. Last accessed June 2018.



44. Pascoe DD, Ring EF, Mercer JB, Snell J, Osborn D, Hedley-Whyte J. International Standards for pandemic screening using infrared thermography. In: Molthen RC, Weaver JB, editors. *Medical Imaging 2010: Biomedical Applications in Molecular, Structural and Functional Imaging*. Proc SPIE. 2010;7626: 72261Z p.1-8.
45. Ring EF, Kalicki B, Zuber J, Rustecka A, Vardasca R. New standards for fever screening with thermal imaging systems. *J Mech Med Biol*. 2013;**13**(2): 1350045-1-12 DOI: 10.1142/S0219519413500450.
46. International Organization for Standardization. *Medical electrical equipment—deployment, implementation and operational guidelines for identifying febrile humans using a screening thermograph*. ISO/TR 13154: 2017. Geneva: International Organization for Standardization (ISO); 2017.
47. *Lloyd's List Law Reports*. House of Lords. The "Queen Mary". Oct. 13,14,15,18,19,20,21,27,28,29,Nov.1, 1948. 28 March 1949;**82**(8):303-43.
48. Bisset J. *Commodore: war peace and big ships*. New York: Criterion Books; 1961. Chapter 37. The 'Queen Mary' cuts a cruiser in halves—her remarkable collision with the 'Curacao'; p.380-2.
49. To be a companion of the Distinguished Service Order (DSO). Captain John Wilfrid Boutwood, Royal Navy. Third Supplement to the *London Gazette*. 1943 Dec 7: 36275; 5333.
50. Marquess of Milford Haven OBE 1942, DSC 1942. In: *Who's Who: An Annual Biographical Dictionary*. London: Adam and Charles Black; 1966. p. 2110.
51. Legion of Merit in the Degree of Commander. Vice Admiral Sir Sheldon Francis Dudley, British: Army. July 1942 to May 1945. United States War Department. General Orders No 128. Washington: US War Department; 1946. p. 3.
52. For service as Medical Director General of the Navy: *Legion of Merit, Degree of Commander*. Vice Admiral Sir Sheldon Francis Dudley, K.C.B., O.B.E., F.R.S., M.D., F.R.C.P. (Lond.), K.H.P. (Retired) Fourth Supplement to the *London Gazette*. 1946 Dec 3: 37805; 5911.
53. Dudley SF. *Our National ill health: an essay on the preservation of health*. London: Watts and Co.; 1953.
54. Dudley SF. *The four pillars of wisdom: a rational approach to a healthy education*. London: Watts and Co.; 1950.

