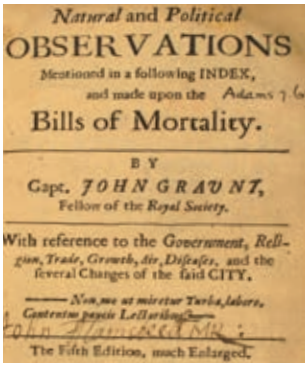
Natural and Political
OBSERVATIONS
Mentioned in a following INDEX,
and made upon the Bills of Mortality.
BY
Capt. JOHN GRAUNT,
Fellow of the Royal Society.
With reference to the Government, Religion, Trade, Growth, Air, Diseases, and the several Changes of the said CITY.
The Fifth Edition, much Enlarged.

Fig 1 | Title page of Graunt's pamphlet

Deaths in 17th century London

What can we learn from John Graunt's seminal analysis, ask **Will Stahl-Timmins and John Appleby**

In 1662 John Graunt published a pamphlet called *Natural and Political OBSERVATIONS mentioned in a following INDEX, and made upon the Bills of Mortality.*[1] His analysis of the records of deaths ("burials") and births ("christenings") in London was seminal. The rather plain looking pamphlet (fig 1) contained large tables of figures, from records collected weekly by parish clerks from 1629 to 1660. Causes of death included "King's Evil," "falling sickness" or simply "found dead in street." Figure 2 shows the top 20 causes of death recorded in this dataset.

Data accuracy

The tables presented in the report look rather like a spreadsheet—but one drawn by hand using a quill pen (fig 3). Pulling together hundreds of weekly records over decades enabled Graunt to pick out trends, to offer explanations for differences in mortality between areas of London, and to establish, for example, that around a third of all deaths each year in the early to mid-1600s were of children aged under 6.

A haberdasher by profession, Graunt notes in his publication some self deprecatory words to the effect that he hopes the data he presents make a real difference to the world and that he recognises others may find errors.

> "*For herein I have, like a silly Scholeboy, coming to say my Lesson to the World (that Peevish, and Tetchie Master) brought a bundle of Rods wherewith to be whipt, for every mistake I have committed.*"

Not to be too "peevish" or "tetchie,' but in translating Graunt's table of deaths ("casualties") from a web based version[1] to a spreadsheet, it was clear that some of his totals were wrong. We have corrected these in our figures. The arithmetic mistakes, however, are probably less important than problems with the raw data. Graunt was well aware of the basic problems with the accuracy of data he collated.

> Aside from plague epidemics, the main killers were "consumption and cough"

Ascertaining the cause of death can be difficult for an experienced physician, and those who collected these data were not doctors nor necessarily had access to professional advice. Many deaths would have simply gone unreported. Nevertheless, he was circumspect about problems with the data and was able to bust a few common myths of the time—that London's population must number in the millions (it was more like 400 000) or that people's fears of certain diseases were out of proportion with the actual numbers of deaths.

Causes of death

So what kind of illnesses and diseases did people die of in

Fig 2 | Gravestones sized according to the top 20 diseases in the dataset. Calculations are based on area

17th century London? "Canker, sore mouth, and thrush"—not a Dickensian firm of solicitors—was, thankfully, a minor cause of death, with only around 700 deaths over the 22 years presented. "Wolf" accounted for eight deaths in 1650 and leaves a gaping hole of a back story to be told. "King's Evil"—or scrofula, a tubercular infection of the throat lymph glands and named on the belief that the cure was a touch from a monarch—accounted for an average of around 30 deaths a year between 1629 and 1660. All 80 causes of death in the dataset are shown in fig 4.

Aside from plague epidemics, the main killers were "consumption and cough," "chrisomes and infants," and "ague and fever." So, a combination of tuberculosis (plus other wasting illnesses), infant mortality, and a set of feverish symptoms that probably covered quite a range of distinct diseases. The profile of mortality certainly looks very different from today's, with far higher numbers of deaths attributable to infectious diseases, rather than cancer, heart disease, and stroke.[2]

When it happened, the effect of a plague epidemic was dramatic. At this time, London could lose up to 20% of its population to plague every 20-30 years,[3] until after the "Great Plague of London" in 1665, during which 68 596 plague deaths were recorded in bills of mortality (although the real number was probably closer to 100 000).[4]

Classification challenges

Accurate and consistent classification of deaths was a problem for Graunt 350 years ago. Great progress has been made since then in systematising attribution of causes of death. The ICD-10 International Classification of Disease and causes of death[5] includes six subcategories for bubonic plague (A20.0, including cellulocutaneous plague (A20.1) and septicaemic plague (A20.7)). But problems remain, especially in developing countries, many of which lack comprehensive systems for capturing important health data.[6] Reforms have also been tabled recently in the UK, where new local "medical examiners" will begin checking death certificates from April 2019 to improve accuracy and compliance with regulations.[7]

It is easy to be dismissive of Graunt's work because of the archaic medical terms he used and the very basic data collection methods available to him, but the problems he was grappling with are a matter of continuing debate. A degree of imprecision remains, which means that even this most basic of health statistics often remains subject to estimate rather than record.

Graunt died in 1674, aged 53, contributing one more statistic to the burial record that year (for jaundice).

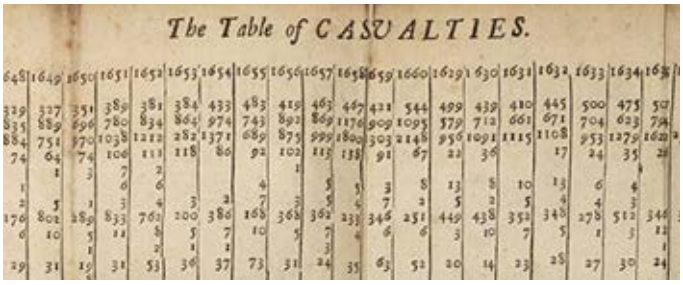

Fig 3 | *The table of casualties* from Graunt's manuscript

John Appleby, chief economist, Nuffield Trust, London
john.appleby@nuffieldtrust.org.uk
Will Stahl-Timmins, data graphics designer, *The BMJ*, London

Cite this as: *BMJ* 2018;363:k5014

1 Consumption and cough - 46 583	21 Stopping of the Stomach - 1067	41 Thrush - 311	61 Head-Ache - 51
2 Chrisomes and infants - 32 106	22 Killed by several Accidents - 1021	42 Grief - 279	62 Starved - 51
3 Ague and fever - 23 615	23 Jaudice - 998	43 Quinsy and Sore-throat - 247	63 Cut of the stone - 38
4 Plague - 16 384	24 Plague in the Guts - 991	44 Found dead in the streets - 243	64 Smothered and stifled - 26
5 Aged - 15 926	25 Stone and Stangury - 863	45 Tissick - 242	65 Frighted - 21
6 Teeth and Worms - 14 236	26 Worms - 827	46 Hanged and made away with themselves - 222	66 Mother - 18
7 Flox and small Pox - 10 576	27 Drowned - 826	47 Rupture - 200	67 Wen - 15
8 Convulsion - 10 363	28 Measles - 767	48 Lunatique - 158	68 Bleach - 14
9 Dropsy and Tympany - 9077	29 Canker, Sore mouth and Thrush - 699	49 Vomiting - 136	69 Poysoned - 14
10 Abortive and stillborn - 8559	30 Scurvy - 644	50 Gout - 134	70 Calenture - 13
11 Bloudy Flux, Scouring and flux - 7787	31 Cancer, Gangrene and Fistula - 621	51 Meagrom - 132	71 Itch - 11
12 Rickets - 3681	32 Cold and cough - 598	52 Burnt and scalded - 125	72 Sciatica - 11
13 Childbed - 3364	33 King's Evil - 537	53 Blasted - 99	73 Wolf - 8
14 Surfet - 3104	34 Overlayd and starved at Nurse - 519	54 Jaw-faln - 95	74 Leprosy - 8
15 Mother, Rising of the Lights - 2504	35 Sores, Ulcers, broken and bruised - 504	55 Murdered - 86	75 Scal'd-head - 5
16 Purples and spotted Fever - 1845	36 Sodainly - 453	56 Falling sickness - 74	76 Cramp - 2
17 Impostume - 1638	37 Pleurisy - 425	57 Spleen - 68	77 Excessive drinking - 2
18 Livergrown, Spleen and Rickets - 1422	38 Palsy - 423	58 Lehargy - 67	78 Shingles - 2
19 Collick and wind - 1389	39 French-Pox - 402	59 Bleeding - 65	79 Fainted in bath - 1
20 Apoplex and suddenly - 1306	40 Executed - 366	60 Swine-Pox - 57	80 Stitch - 1

Fig 4 | Causes of death and total number of deaths recorded between 1629 and 1660