Issues pertaining to posology in ancient Greek, Roman and Byzantine medical texts

Elias Valiakos, Marios Marselos, Athanasios Diamandopoulos

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Elias Valiakos¹, Marios Marselos², Athanasios Diamandopoulos³

Abstract

Researching medical texts of the past reveals that the preparation of a therapeutic recipe usually involved the use of several active ingredients. There are many detailed reports on the ratio of the ingredients in a recipe, but also on the dosage administered to the patient. In this article, we recorded the use of units of weight and volume in therapeutic recipes from antiquity, the Hellenistic era, the Roman Empire, Byzantium, and also empirical medical texts of the 19th century. The changes emerging over time from the growing trade in the wider Mediterranean area, with the introduction of both new products and new units of measurement, did not affect the basic principles of the therapeutic methods. Through the centuries, the main concern of physicians was to fight the disease without burdening the patient with any unwanted effects. In this context, we observe even dosage modifications when it comes to special vulnerable population groups, such as children, the elderly and pregnant women. The period covered is very large, which means that the approach is impressionistic not aiming to the philologists. We hope that this does not pose a problem to the interested historians of medicine.

Key Words: Ancient recipes, posology, weight and volume units, iatrosophia

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Figure 1. Sir Christopher Wren’s window at the Oxford University Museum of the History of Science, Oxford, England. It depicts Sir Isaac Newton’s dictum “numero, pondero, et mesura Deus omnia condidit” (God created everything by number, weight and measure).
Introduction

1st AD: “A little bit of opium poppy (a dose of orobos) is an analgesic, a hypnotic, and a digestive, sooths coughing and abdominal cavity afflictions. Taken as a drink too often it hurts (making people lethargic) and may be lethal” Dioscorides, 1st cent. AD.

13th cent AD: “The therapeutic agent (the medicament) […] must be given in analogous amount with the strength of the morbid agent. Because if it exceeds it will affect the neighbouring parts [of the body], exactly as when the fire burns out all the fuel, it ignites the neighbouring material, similarly the medicaments dealt with the intruder, then affect the body parts” Bishop Apocaukos of Nafpaktos, 13th cent. AD.

These two extracts from Greek texts, twelve centuries and two Faiths (Paganism and Christianity) apart, prove authors’ continuous preoccupation with the precise dose of a prescribed drug and their fear over toxic side effects. To determine the “how much”, it was necessary to agree how this is weighted, that is the posology. In current scientific terminology, posology is a very important branch of modern pharmacology and therapeutics, being the science of dosage (from Greek pόsos, how much, and lόgos, study) concerned with “treatment dosage” and “dosage regimen”.

The earliest uniform systems of weights and measures that are currently known to us appear to have been formulated during the 4th and 3rd millennia BC among the ancient peoples of Egypt, Mesopotamia and the Indus Valley, and perhaps also Elam (in Iran). According to early Babylonian and Egyptian records and the Hebrew Bible, length was first measured with the forearm, hand, or finger and time was measured by the periods of the sun, moon, and other heavenly bodies. When it was necessary to compare the capacities of containers such as gourds or clay or metal vessels, they were filled with plant seeds which were then counted to measure the volumes. When weighing means were invented, seeds and stones served as standards. For instance, the carat, still used as a unit for gems, was derived from the carob seed.

Accurately defining units of measurement, be it for weight or volume, is invariably a problematic issue due to their significant variability throughout different periods of history. In certain cases, a unit may even have varying values from one place to another within the same historical context, depending on the standards set by the authorities. For instance, even though the silver coin δβολός (obol) corresponded to the basic weight measurement in ancient Greece, in recipes of the Corpus Hippocraticum it is encountered with three different values, as the obol of Athens (Λττικός), of the island of Aegina (Αλγναίος), and of the island of Rhodes (Ρόδιος) (Table 1).

As expected, each historical period retained a traditional set of weight and volume units, whilst also introducing novel ones, tailored to the requirements of expanding commercial activities in new territories. Tables 2 and 3 demonstrate that the Roman and Byzantine measures include numerous units originating from antiquity, in addition to several newly established ones. It is noteworthy that a new weight unit, named the dram, which emerged during commercial transactions in the late Byzantine period, was in fact the Persian dirham, originating from the Greek drachma. Despite their similar names, the Greek drachma and Persian dirham represented different weight values (see Tables 1 and 3). Moreover, further difficulties are encountered when we try to transliterate the Greek name of a dose to other languages. Indicatively, the Syriac qūqāyā appears to come from the Greek kokkion, a diminutive of kókkos (“berry”), which is also used to denote “pills”. But there also is the word qūqā that may originate from kaukos (a cup) or kókkos (berry). Furthermore, the Syriac qūqāyā can also mean ‘potter’.

It may be easier to comprehend the ancient Greek medical texts on drugs, including their dosages and side effects, in this cultural context. However, the desire to establish precise drug dosages did not emerge suddenly in Greece, nor did it disappear abruptly after the fall of the Byzantine Empire. Everything in science – as in any other aspect of civilisation – took a considerable amount of time to develop and refine, or to be discarded entirely. Thus, the main body of this article is proceeded by a short reference to the ancestors of Greek medical texts on dosages and followed by a reference to their descendants. Our focus is solely on textual evidence from regions surrounding the Eastern Mediterranean.

i. The ancestors

The ancient Egyptians were very accurate in specifying each drug dose prescribed. Indicatively, incantations were recited when weighing a prescription’s ingredients. Moreover, the patient’s name in the Egyptian Medical papyri (1800 – 1300 BC) was always written in red ink while the ingredients were in black, with dosages in red.

The Ebers Papyrus contains 850 recipes for various ailments where all the doses are written in red. An indication of the observance by the Egyptians of the exact quantity of a drug’s ingredients:
## Issues pertaining to posology in ancient Greek, Roman and Byzantine medical texts

### Table 1. Ancient Greek units in medical prescriptions.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Equivalent</th>
<th>Modern equivalent</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ὀβολός (obol)</td>
<td>Based on the barley grain:</td>
<td>0.72 g</td>
<td>A silver coin of the Attic standard. The Aegina obol was 1.05 g.</td>
</tr>
<tr>
<td></td>
<td>twelve grains to one obol.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>κεράτιον (keration)</td>
<td>About ¼ of an obol</td>
<td>0.19 g</td>
<td>A seed of the carob tree (<em>Ceratonia siliqua</em>). Dichalcon: a double chalcus (a copper coin).</td>
</tr>
<tr>
<td>δίχαλκον (dichalcon)</td>
<td>(three barley grains).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>δραχμή (drachma)</td>
<td>6 Attic obols.</td>
<td>4.31 g</td>
<td>As a weight unit, drachma is mentioned also as ὅλκη (holkē).</td>
</tr>
<tr>
<td>μνᾶ (mina)</td>
<td>100 drachmæ.</td>
<td>431 g</td>
<td></td>
</tr>
<tr>
<td><strong>Liquid and dry volume units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>κοχλιάριον (kochliarion)</td>
<td>4.5 mL.</td>
<td></td>
<td>A small spoonful.</td>
</tr>
<tr>
<td>χήμη (chēmē)</td>
<td>2 kochliaria.</td>
<td>9.1 mL</td>
<td>A spoonful.</td>
</tr>
<tr>
<td>μύστρον (mystron)</td>
<td>2.5 kochliaria.</td>
<td>11.4 mL</td>
<td>A large spoonful.</td>
</tr>
<tr>
<td>κόγχη (konchē)</td>
<td>5 kochliaria.</td>
<td>22.5 mL</td>
<td>A shell-full.</td>
</tr>
<tr>
<td>κύαθος (cyathos)</td>
<td>10 kochliaria.</td>
<td>45 mL</td>
<td>A small cup with a handle.</td>
</tr>
<tr>
<td>ὀξύβαφον (oxybaphon)</td>
<td>1,5 cyathoi.</td>
<td>67.5 mL</td>
<td>A shallow cup for vinegar.</td>
</tr>
<tr>
<td>κοτύλη or ἡμίνα (hēmina)</td>
<td>6 cyathoi.</td>
<td>270 mL</td>
<td>A large cup with two handles (the Roman kotyla or hemina).</td>
</tr>
<tr>
<td>ξέστης (xéstēs)</td>
<td>12 cyathoi.</td>
<td>540 mL</td>
<td>A large vessel.</td>
</tr>
<tr>
<td>χοῖνιξ (choinix)</td>
<td>24 cyathoi.</td>
<td>1.08 L</td>
<td></td>
</tr>
<tr>
<td>χοῦς (chos)</td>
<td>72 cyathoi.</td>
<td>3.24 L</td>
<td>A pitcher (the Roman congius).</td>
</tr>
<tr>
<td><strong>Figurative description of size or dry volume</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Eb 5

*Another (remedy) for an abdomen that has pain:*

*Cumin: 1/64 (dja), goose fat: 1/8 (dja), milk 1/16 (dja) (oipe=4 dja).*

[2.15a] To be cooked; (then) squeezed out, (and) drunk.

### Eb 6

*Another remedy:*

*Figs: 1/8 (dja), Egyptian balsam fruit (?): 1/8 (dja), sweet beer: 1/16 (oipe=4 dja)*

[2.20a] (To be treated in the same manner).

Later, we refer to a recipe inscribed on a clay Babylonian tablet of the 7th/6th cent. BC for treating menorrhagia.

“If a woman’s blood flows and does not stop, to stop it: you prescribe (lit. “give her”) alum, reddish kalgukku-mineral, [a mixture?] for ‘soaking’; thereafter you give her the (mixture) for ‘soaking’ and ‘damming up’ (the flow); thereafter you give her this mixture [of alum?] and reddish kalgukku-mineral: You roast alum, kalgukku – […], you make [a suppository?]. These drugs, as much as one has told you (to be appropriate), she applies one at a time, until? the wetness? Is […]”

Moving several centuries later, we read at the Babylonian Talmud written between the 3rd and 6th century AD but incorporating many older recipes, the very comprehensive remedy for an anal “split” (fissure): “take 7 grains of worm(-coloured) alkali-plant, wrap them inside the neck (of a garment), wind it in thick cord, decoct it in white balm, roast it and spread it upon it (the anus)”

**Description**

- ἀστράγαλος (astragalos)
- ὅροβος (orovos)
- κάρυον Ποντικόν (karyon of Pontus)
- κάρυον Θάσιον (karyon of Thasos)
- κύαμος (kyamos)

**Remarks**

- A bone of the foot, in some instances specified, as e.g. astragalos of a deer.
- A small round seed (ervil) similar to a pea, from the plant *Vicia ervilia*.
- The hazelnut, nut of the shrub *Corylus colurna*.
- The almond, nut of the tree *Amygdalus communis*.
- The broad bean, the seed of the plant *Vicia faba*.
Table 2. Roman units in medical prescriptions.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Equivalent</th>
<th>Modern equivalent</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>uncia (Roman ounce)</td>
<td>1/126</td>
<td>36.7 g</td>
<td>The units of weight were mostly based on factors of 12.</td>
</tr>
<tr>
<td>siliqua (carat)</td>
<td>1/486</td>
<td>0.19 g</td>
<td>Derived from unus (one), as a “single unit” of weight.</td>
</tr>
<tr>
<td>obolus (obol)</td>
<td>1/486</td>
<td>0.57 g</td>
<td>From the Greek word ὀβόλος (a metal stick). It differs as a weight from the Greek obol.</td>
</tr>
<tr>
<td>scrupulum (scruple)</td>
<td>1/576</td>
<td>1.14 g</td>
<td>It means a “small pebble” and corresponds to the Byzantine gramma.</td>
</tr>
<tr>
<td>libra (Roman pound)</td>
<td>12</td>
<td>328.8 g</td>
<td>Twelve Roman ounces equal a libra.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A “balance”.</td>
</tr>
<tr>
<td><strong>Liquid and dry volume units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ligula</td>
<td>1/288</td>
<td>11.4 mL</td>
<td>A large spoonful.</td>
</tr>
<tr>
<td>cyathus</td>
<td>1/72</td>
<td>45 mL</td>
<td>A small ceramic cup.</td>
</tr>
<tr>
<td>acetabulum</td>
<td>1/48</td>
<td>68 mL</td>
<td>The Greek oxybaphon.</td>
</tr>
<tr>
<td>quartarius</td>
<td>1/24</td>
<td>136 mL</td>
<td>“One fourth”, from its relation to the sextarius.</td>
</tr>
<tr>
<td>hēminai or kotyla</td>
<td>1/12</td>
<td>273 mL</td>
<td>A large cup with two handles.</td>
</tr>
<tr>
<td>sextarius</td>
<td>1/6</td>
<td>545 mL</td>
<td>The “Roman pint”, with double the volume of hēminai.</td>
</tr>
<tr>
<td>congius</td>
<td>1</td>
<td>3.27 L</td>
<td>The Greek chous.</td>
</tr>
</tbody>
</table>

Table 3. Byzantine units in medical prescriptions.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Equivalent</th>
<th>Modern equivalent</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight units</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>οὐγγία (ouggía)</td>
<td></td>
<td>27.3 g</td>
<td>Byzantine ounce.</td>
</tr>
</tbody>
</table>
| γράμμα (gramma), or τρημίσις (trēmísis) | 1/24 of an ounce. | 1.14 g | Roman scrupulum  
| σημίσις (sēmísis)     | 1/12       | 2.27 g            | semissis                                                      |
| δράμι (drāmi)         | 1/8        | 3.88 g            | The Persian dirham, from the Greek drachma (approximately 3 grammes). |
| νόμισμα (némisma)     | 1/6        | 4.55 g            | nomisma (coin).                                               |
| **Liquid and dry volume units** |         |                   |                                                                |
| οὐγγία (ouggía)       | 1/12       | 0.1824 Lt         | Liquid Byzantine ounce.                                       |
| κοτύλη (kotýlē) or ἡμιξέστιον (hēmixéstion) | 1/8 of a litre. | 0.276 Lt | Roman kotyla or half-sextarius.                                |
| ξέστης (xésēs)        | 1/4        | 0.548 Lt          | Roman sextarius.                                             |
| ἱλίτρα (litra)        | 1          | 2.1888 Lt         | Roman libra.                                                 |

These three extracts represent an embryonic form of the science of posology.

ii. Greek medical writings from the 5th cent. BC to the 15th cent. AD

Material

The following authors were selected for further analysis, because their treatises represent different periods in medical history (Ancient Egypt, ancient Greece, Hellenistic era, Imperial Rome, Byzantium and its offspring): Egyptian Medical Papyri (2.000 BC – 4th cent. BC), Hippocratic Corpus (5th/4th cent. BC), Nicander a. (2nd cent. BC), Dioscorides (1st cent. AD), a. Nicander (2nd cent. BC) was born in Colophon of Asia Minor, but spent most of his life in Alexandria. His text “Theriaca”, in the hexameter verse, was a didactic work on the treatment of snakebites. He also wrote “Alexipharmaca”, dedicated to the treatment of poisoning.
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Results and Discussion

We accordingly classified our findings into the Classic Era, the Hellenistic and Roman Period and Byzantium and its descendants.

a. Classic Era

Several therapeutic recipes with information on the preparation and administration of remedies are encountered in books of the Hippocratic Collection. In general, recipes contain only a few references to weight units, which were δραχμή (drachma) or δλη (holkē), ὀβολός (obolos), στατήρ Αἰγιναῖος (stater of Aegina), μνᾶ (mina) (Table 1). There are also descriptions of rather vague dosages, with references to common utensils, such as κύαθος (cyathos, a small cup sometimes with a long handle), κοτύλη (kotylē, a large cup), και ὀξύβαφον (oxyvaphon, a saucer-like shallow cup). Additionally, the morphology of various natural products is used for the empirical description of units corresponding to weight or volume, such as ἀστράγαλος (astragalos, a bone of the foot), ὄροβος (orobos, ervil), κύαμος (kyamos, broad bean), κάρυον Ποντικόν (karyon of Pontus, hazelnut), κάρυον Θάσιον (karyon of Thasos, almond) (Table 1).

The lack of specific and reliable information on the preparation of remedies and dosages for patients contradicts the well-established ethical principles of the Hippocratic physicians, who pursued the well-being of their patients through accuracy in posology, to ensure effective treatment without adverse effects11. It is believed that such information was depicted in one or more books with the title Pharamakitis, as stated in the paragraphs 9, 15, 18 and 23 of the book Internal Affections5,12. Exceptionally, the treatises Diseases of Women contain several recipes with full instructions on the weights for preparing and administering a medicament. For example: "Another: one obolos of castoreum or sagapenum, one drachma of bitumen, two of soda; crush all these in sweet wine and oil, in the amount of half a kotylē. Give two oboloi to drink whilst fasting"13, or "Purgative enemas for the womb if it is ulcerated after birth or if there is inflammation: winter wild figs; cover with water, boil, sieve and leave to rest. Then add lukewarm oil and mix; inject two kotylai at the most. No enema should exceed this amount"14. For a detailed discussion on weights in Hippocratic texts, see Totelin15.

Method

A recipe description typically comprises the following parts: a. a title; b. clinical indications; c. a list of ingredients (herbal, animal, or mineral products) with the respective weight or volume units; d. instructions for the preparation of a homogenous mixture, with the appropriate formulation (oral solution, pill, lozenge, collyrium, pumice etc.); e. treatment instructions (dosage and frequency of administration). We have focused on remarks on the right dosage and duration of treatment and on descriptions of possible side effects as a result of therapy. Emphasis was placed on recipes containing details on posology, especially when prescriptions contained statements suggesting specific concerns for particular groups of patients, such as children, the elderly, or pregnant women.
b. Hellenistic and Roman Period.

Dioscorides (circa 40 AD-90 AD) includes almost 360 weight or volume measures for ingredients in his treatise *Materia Medica* (teaspoonful: 144 times, grains: 60, ounces: 56, gallons: 39, cupful: 38, litre: 14, kilo: 6)\(^1\). In some instances, the instructions show a clear concern for the adjustment of dosages, when needed, as is the case of a recipe containing squiring cucumber (*Echallium elaterium*), advocated in patients with dyspnoea, when necessary to clear excess phlegm and bile. Posology, is modified, as follows: “...the ideal dose is an obolos and it should not be less than half an obolos; to children use only a dichalcon [1/4 of an obol]; when given at larger doses, it is harmful”\(^2\).

Hyoscyamus niger, “[...] and the seed doth perform the same things [...] as much as an obolos is drank [...]”\(^3\).

As mentioned already, Dioscorides seems well-informed on the possible risks of overdosing, when he describes the properties of opium poppy: “A little of it (a dose of orovos) is an analgesic, a hypnotic, and a digestive, soothes coughing and abdominal cavity affictions; taken as a drink too often it hurts (making men lethargic) and may be lethal”\(^4\).

Krataiogonon, “[...] It is said that drinking of the seed doth cause a woman to bring forth a male. If [...] do drink fasting, 3 times a day the quantity of 3 oboloi with 2 cyathoi of water for 40 days”\(^5\). Apsinthion (*Artemisia absinthium*), “[...] is good also for inflations and engendered. Then anoint all your limbs, be it for a journey or for a sleep or when you gird yourself after eating; for in them a venom no less deadly is shaped, well-made pestle and pound up these many ingredients in a mixture with the snakes; but cast aside them up and, after having softened them with vinegar, apply for 1 hour; no more, so that the spleen does not liquefy completely”\(^6\). Furthermore, for patients with spleen ailments, there is another recipe for a solution to be administered internally: “Take willow bark and boil it, and for three days [give the patient to] drink the third left of the boil; do not administer more; otherwise, you will deprive him of spleen”\(^7\).

Some recipes also contain recommendations for dose adaptations in special groups of patients: “Against pains in the urethra, urine retention, difficulty in urinating, for those who urinate blood and suffer from stones; it is called "of Hippocrates" or "herbal"; equal parts of *asarum*, *meum* [baldmoney], celtic spikenard; mix with Attic honey; administer a dose the size of a hazelnu to robust people, but to children and the elderly less...”\(^8\).

A similar recipe exists for patients with dyspnoea: “Give one or half a spoonful of sodium carbonate to lick with honey or tempered wine; for children, give half the dose”\(^9\). Interestingly, for highly toxic substances, such as antimony, lead or mercury, medical applications were restricted to topical use only. These examples demonstrate that Aelius Promotus’ recipes reflect a certain degree of accumulated experience, through successful and failed trials, which he used for the benefit of his patients. It was during his era and in his region that lead cosmetics were overused\(^10\), although lead powder had been documented as a cosmetic ingredient since Bronze Age\(^11\).

As previously mentioned, the accurate reproduction of a recipe was crucial, not only in terms of the ingredients used but also in their proportions. This ensured that treatments were effective and safe, without any side effects or toxicity. We know that Nicander, Andromachus the Elder\(^12\) and Damocrates\(^13\) were three physicians who used versed recipes in order to facilitate memorization. *Theriaca* is the longest surviving poem by Nicander\(^14\); it deals with the bites and stings of venomous animals, and describes antidotes for them. Bellow there is a fragment of *Theriaca*\(^15\):

 [...] If however you can cast snakes coupled at a crossroads, alive and just mating, into a pot, and the following medicaments besides, you have a preventive against deadly disasters. Throw in thirty drachmas’ weight of the marrow of a freshly killed stag and one-third of a chous of rose-oil, - essence which perfumers style ‘prime’ and ‘medium’ and ‘well-ground’ - and pour on an equal measure of raw, gleaming oil and one-quarter of wax. These you must quickly heat in a round, bellying pot until the fleshy portions are softened and come in pieces about the spine. Next take a shaped, well-made pestle and pound up these many ingredients in a mixture with the snakes; but cast aside the vertebrae, for in them a venom no less deadly is engendered. Then anoint all your limbs, be it for a journey or for a sleep or when you gird yourself after work at the threshing-floor in summer’s drought and

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\(^{1}\) Andromachus the Elder (1st cent. AD), a Greek who lived in Rome, was the personal physician to Emperors Nero, Claudius, and Augustus. He is credited with the creation of several recipes written in verses, including *mithridatum*, a variation of an antidote similar to *thēriakē*, attributed to Mithridates VI, the king of Pontus. The original recipe was allegedly brought to Rome as a trophy, after the Mithridatic wars (88-63 BC).

\(^{2}\) Damocrates (mid to late 1st cent. AD) was a Greek physician at Rome. His medical treatises in the iambic verse are lost, but some extracts have been preserved by Galen.
Galénnē, a variation of thēriakē against snakebites, which was written as an eighty-seven elegiac distich poem. It continued to be used for many centuries after 32. A recipe of the famous Venetian thēriakē, c. 1630, is shown in Figure 23. The English translation of its beginning reads: "Hear the vigorous power of the antidote of many virtues Caesar, giver of the peaceful freedom. Listen, Nero; it is called Galene, cheerful and serene, which does not worry about the dark ports, neither is it defeated if one would drink avidly from a hateful cup in which has been squeezed bundles of poppy".

Galen (2nd/3rd cent. AD) was pedantic on the accuracy of the weights for herbal ingredients and doses. He expresses his anger on the variations in weight in various terms used in pharmacopoeia: "But among those who have written about weights and measures there has been disagreement on how much the weight of the mna is [...] some say that the mna consists of sixteen unciae, others of twenty, and still others draw a distinction, saying that the Alexandrian mna consists of twenty unciae, whereas the other consists of sixteen, and this is smaller. But among those who convert the mna into drachmai some say the mna consists of a hundred drachmai, others say of more, since most people also say that the uncia consists of seven and a half drachmai, while others say only seven and others again eight. This being so, it is difficult to discover how many drachmai one should calculate the mna recorded by Crito in his prescription".

Indicatively, in the treatise "On Theriac to Piso", which is arguably attributed to him, Galen gives accurate instructions for preparing thēriakē: "Weigh out rose petals equal to 12 drachmas and add Illyrian iris and mix in an equal amount of sweet-boughed black liquorice and the seeds of sweet French turnip. Add the juice of fragrant garlic germander, taking Assyrian balsam from within. Put in the same amount of cinnamon by weight and do not forget to add an equal amount of agaric and myrrh and sweet scented Saussurea Lappa and crocus grown in the Corycian cave and [...] Take the weight of one bean which the well-shaded water has nourished in the water, hidden by many petals of the Nile bean, mixing it with three tablespoonfuls of warm water [...]".

Galen wrote a thorough treatise on weights and measures, although its authenticity is questioned. An excellent collection of all his references on the subject in this treatise as well as similar others scattered into his various writings was published with comments in...
During Galen’s time, poetic recipes were prevalent, particularly those written in elegiac meter as opposed to Nicander’s hexameter. The resurgence of elegiac poetry occurred alongside the flourishing of the Second Sophistic movement. The creators of “elegiac pharmacology” were not only interested in conveying precise prescriptions but also in showcasing their overall education, or “paideia”. Characteristically, Aglaia of Byzantium, a Hellenistic poet from the 1st century AD, composed a riddle poem for the treatment of cataracts, including various drug weights, which he addressed to a scholarly acquaintance:

“[…] Five obols of the flower of copper, and the same weight of the lovely mother of him that was slain by a boar. Add too one obol less than these of the fiery grain which grows in the Callatican fields; and also twice the weight of two drachmas, one from the tawny-haired flower, and take the other from the genitals of the tamer of horses, of which let half the weight be of the homonymous father who gave his daughter in marriage to the son of a female slave”.

There is an abundance of allegories to Homer and other myths which only an equal learned addressee like Aglaia could understand. A number of points of interest reveal the poet’s shot at originality. The first is found in line 10, which contains the enigmatic “lovely mother of him that was slain by a boar”. It alludes to Adonis who was killed by a boar. His mother’s name was Smyrna, who after her death was turned to a homonymous tree. Thus, the poem refers to smyrna, alias myrrh, from which five obols should be used. Several other similar mythological allusions are used to decipher the whole recipe.

c. Byzantium

Early Byzantine medical writers were also meticulous in specifying precise weights for the medications they prescribed. This is evident in the numerous Greek medical papyri discovered in Antinoopolis, Egypt. In terms of therapeutics, they usually comprise extensive descriptions of medicinal preparations, rather than mere ingredient lists. Instead, the recipes usually provide ranges of application, ingredients with doses, and precise directions for administration, which have not been entirely omitted even when prescriptions are copied concisely.

Referring to the dosage of a medicine for the treatment of malaria (then known as “tertian” or “quartan” fever), Philumenus (3rd cent. AD) recommends the administration of three drachmas for adults and half the amount for children.

St. Epiphanius of Salamis (315-403 AD) wrote an extensive treatise “On Weights and Measures” in Greek preserved mainly through Syriac translations. Using his able knowledge of five languages he elaborated on the weights and measures referred in the Bible and their variable equivalents to the then used weights in the Greco-Roman world.

Oribasius, in the 4th cent. AD, personal physician to Emperor Julian the Apostate, describes a lozenge as a recipe of Andromachus, with a recommended dosage of 3 to 4 drachmas for adults, which should be reduced to 2 drachmas for paediatric patients. Similar recommendations for dosage reductions are also found in the treatise Βιβλία ἰατρικά ἐκκαίδεκα (Eleven Medical Books) of Aëtius of Amida (6th cent. AD). One worth mentioning dates back to the Ptolemaic era in ancient Egypt. It cites a recipe of Nechepso, with instructions for administering one twelfth of a drachma (holkē) to melancholic patients and to children with respiratory problems.
Paulus of Aegina (7th cent.) presents a Galen’s medicine for epilepsy, with pulp from the bulb of squill (Scilla maritima) mixed with honey. The daily dose for adult patients is a large spoonful, while children should be given a small spoonful.52

The monk, philosopher, poet and astronomer Nicephoros Vlemmydes (13th cent.) wrote two books on medical themes. One was the “Περὶ Ἰατρικῆς” (On Medicine) and the «τοῦ σοφωτάτου καὶ λογιωτάτου κυροῦ Νικηφόρου τοῦ Βλεμίδου εἴδησις τῶν ἰατρικῶν μέτρων» (A report on medical weights by the wisest and erudite Nicephoros Vlemmydes). In the latter, he describes several units for measuring ingredients for the preparation of drugs and their proper doses. The units were named after their container.53 There is a detailed explanation of the correspondence of various weights and their subdivisions (Fol. 28r).54 Myrepsosoi were spice [and drugs] merchants who traded by weight. They operated from the Portico of Achilles, situated between the Million and the Chalke Gate.55

In his book Dynameron, Nikolaos Myrepsos (13th century) provides numerous prescriptions, with dosages based on the patient’s gender, age, and pathological condition. In case of medicines potentially harmful to pregnant women, such as those including ingredients that may provoke miscarriage, be they of plant origin (euphorbium, hyoscyamus, opopanax, sagapenum), or natural inorganic compounds (cadmia, salmiac), he also describes a recipe bearing the name of Mithridates, to be administered with wine to healthy individuals, but with water in smaller doses to the sick, depending on their condition.56 This is a medicine with more than fifty ingredients, most probably originating from mithridatium, but no reference is made to Andromachus.

d. Later periods

The cultural legacy of historical periods does not simply end with their conventional conclusion. In fact, it often endures for many centuries thereafter. For example, in the case of Byzantium, its legacy, referred to as Byzance après Byzance, persisted long after its Fall in 1453. A prominent figure during the transitional 15th century was Antonios Pyropoulos, who received his education in Constantinople from the renowned medico-philosopher Ioannis Argyropoulos. A depiction of Argyropoulos as a wise teacher can be found in a miniature illustration in Codex Oxoniensis Barocc. gr. 87, which features an epigram in the upper margin identifying some of his students: (Figure 5).

“Argyropoulos teaching the physician Antonios Pyropoulos and Marcos Pyropoulos, along with the physician John Panaretos, and Demetrios Angelos, and Aggalona, the son of Moschos, the physician Vranas of the first master at the Xenon of the Kral”. It also identifies the teaching institution, a very rare characteristic in Byzantine medical illustrations.

There is a treatise by Pyropoulos in the Iberian Monastery at Mount Athos titled “Εξήγησις του Πυρόπουλου περί των σταθμών / των διαγόνων επί τας χώρας και πόλεις τας ημετέρας” (Explanation on weights used nowadays in our counties and towns). It names many weights used in medicine and trade and introduces new ones like “tsoflion” i.e. the amount contained in a nut shell, and the percentage (ἐξάγιον, exagium in Latin) the one who processes it is due to receive.57 In a catalogue titled «De antiquitatis et libris manuscriptis constantinopolitanis» («Περὶ αρχαιοτήτων καὶ χειρογράφων βιβλίων»), B. Foerster (1877) lists an iatrosophion by Pyropoulos. According to Kouzis, this was the source for all “iatrosophia”, that is manuals.
used by empirical healers in Greece up to the 19th century.

Dimitrios Karakassis (Siatista, Northwestern Greece, 1734 - Bucharest, Romania, 1804) was a medico-philosopher, writer and poet. Following a turbulent career with studies in central Europe and teaching at local communities in Greece and the Western Balkans, he became Chief Physician at the Court of Michael Drakou Soutsou, Voivode (Prince) of Vlachia, the heir par excellence of the Byzantine Heritage. There, he wrote five books on medicine. He continued the tradition in using verse for his medical topics: (Fig. 6) as practiced by Andromachus, Nicander, Aglaia, Psellus, Vlemmydes and other Greeks and enriched in the Latin West with the famous medical poem Regimen sanitatis Salernitanum and in the Islamic East with Avicenna’s Canon of Medicine. The second of his poetic books, written in Ancient Greek and Latin was titled “Medical poems B! the apologetic, or the Hippocratic method invalidating the excess use of drugs”. It was inspired by the Hippocratic dictum “quite often the best medicine is no medicine”.

For his poems he used a difficult form of the Greek language, imitating the writers of the 5th-4th century BC, the “attikizousa”. The apologetic second poem with its 1120 verses was a vitriolic attack against the prescription of multiple drugs and excessive doses. In essence, he argued, in the usual Byzantine metaphorical lore, that each disease, like a plant, had one reason, the root, and many branches, the symptoms. An inexperienced doctor prunes the branches with many drugs and leaves the root intact to spring new branches. An experienced doctor, understanding the cause, prescribes one correct drug in the correct amount and counterattacks the cause, destroying the root.

We end with an iatrosophion of the 19th century. The origin and contents of iatrosophia have been described earlier in this article in the section on Pyropoulos. We read: “After our good author Dimitris Xatzi-Apostolis completed the first two entities, he ended his work with four additions, from which the first two are necessary for the correct use of his book and the safe application of the recipes. The first (fol 12r-v) is a very useful record on weights and measures and symbols of chemical substances [...] The list was composed by the author himself in the year 1807.”

Conclusions

Studying historical medical texts can be a cumbersome undertaking due to challenges in identifying the implied nosological entities and the pharmaceutical ingredients used. Equally arduous are matters pertaining to the ingredient ratios in each recipe and the patient dosages prescribed. Notably, weight and volume units have undergone inevitable fluctuations
over time and varied between regions during the same era. Nevertheless, despite all these changes through time, posology remained a subject of significant concern for almost all physicians of the past. The safety of patients has always been a key focus, as evidenced in the precise instructions for recipe preparation and dosage administration. As a result of accumulated clinical experience, certain groups, such as children, the elderly and pregnant women, who are assumed to be more sensitive to particular active ingredients, were typically given a lower dosage. In conclusion, the pharmacological treatises of the past adhered to the long-standing principle exemplified later by Newton’s dictum “numero, pondero, et mesura Deus omnia condidit” (God created everything by number, weight and measure).
14. Ibid, Mul. 1.78 (8.188.24-190.4).
23. Ibid, ν’ 14, 66.
24. Ibid, ιδ’ 6, 68.
26. Ibid, Χ’ 10, 104.
35. On Theriac to Piso, attributed to Galen A critical edition with translation and commentary Submitted by Robert Adam Leigh to the University of Exeter as a Thesis for the degree of Doctor of Philosophy in Classics In July 2013.
38. Ibid, 13.988.4-7
39. Ibid, 14.32. 5-10
40. Ibid, 14.115. 5-12
49. Dean JS (Edt), Epiphanius Treateise on Weights and Measures, The Syriac Version, uchicago.eduS, https://oi.uchicago.edu › shared › docs › saoc11
50. Heilen’s unveiling of Nechepos, Petosiris, Hermes and Asc., skyscript.co.uk, http://skyscript.co.uk › v.

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57. Ibid, p. 124
58. Ibid, p. 628.23-629.4
59. Ibid, p. 115
60. Ibid, p. 231.3-5
61. Ibid, p. 164-5
62. Ibid, p. 677
63. Ibid, p. 405

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