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Environmental similarity index – medical devices

An environmental similarity index (ESI) is proposed to characterise similarity between medical devices and compare such homology to describe and develop better environmental insight into medical devices and environmental waste management policies and controls.

This ESI extends principles espoused by previous workers in other disciplines but is described herein consisting of two components: raw materials of test devices unique and raw materials in common and can easily be expanded to multiple medical devices, as desired.

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In this article, we present a very simple index to use in comparing environmental impact potential of medical devices. Numerous similarity indices have been proposed to measure the degree composition of properties and characteristics but none in the field of medical device environmental waste potential, as far as we are aware.

Composition similarity index

A very simple, un-weighted index representing a medical device can be considered as preliminary comparison ahead of multi-variate analysis, offering potentially rapid acceptance.

This similarity index (ASI %) calculated by company / analysing relative proportion (percentage) of raw materials, constituents, trace elements, *etc* used in medical devices:

$$SI = c \times \frac{100}{a + b - c} \qquad (1)$$

where,

- a = number of raw materials unique to medical device A
- b = number of raw materials unique to medical device B
- c = number of raw materials common to medical device A and B

$$QSI = \frac{2c}{a + b} \times 100 \qquad (2)$$

where

- a = number of raw materials unique to medical device A
- b = number of raw materials unique to medical device B
- c = number of raw materials common to medical device A and B

$$ASI = \frac{d}{a + b + c - d} \times 100 \qquad (3)$$

where,

- a = number of raw materials unique to medical device A
- b = number of raw materials unique to medical device B
- c = number of raw materials common to medical device A and B
- d = number of common raw materials performing same function / intended purpose / contact with body / environmental waste potential

Application of ASI

SI conveys homology (relatedness) in qualitative composition by raw material between 2 (or more) medical devices (for quantitative composition, since material + concentrations / quantities of materials would be required factors).

QSI conveys sum homology proportion (relatedness) in qualitative composition by raw material between 2 medical devices. ASI conveys factors common raw material utility between 2 (or more) medical devices.

When environmental waste potential is factored, for instance, ASI becomes a function of respective or common raw material used for a medical device / between medical devices.

Thus ASI could be utilised to calculate significance (by paired statistics) and is useful in extrapolating medical device environmental waste potential values on a medical device to another.

ASI and the other two indices enable relative environmental impact contributions to be calculated, considering qualitative composition of medical devices. If concentrations / quantities are substituted, then mass ration contribution can be calculated.

Further research is required to establish if environmental end-point can substitute for d (number of common raw materials performing same function / intended purpose / contact with body / environmental waste potential), however, it is conceivable modified Jacquard or weighted methods could be devised.

Furthermore, use of such indices to gauge 0 (zero) environmental impact distance requires research. Methods to achieve this must factor environment impact of manufacture, wider environmental pollution factors, energy production and entire supply and distribution logistics, to permit realistic and meaningful (overall) environmental impact assessment.

Use of similarity indices such as we conceived is suggested to assist medical device manufacturers predict and assure development of environmentally-friendly, eco-design and green medical devices.

This similarity index can assist the medical device industry to describe devices in simpler terms understandable by regulators and non-scientists alike to develop better environmental insight into medical devices and environmental waste management policies and controls.

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