



HOW TO EXTRACT FROM A CLINICAL HISTORY THE INFORMATION NEEDED TO DRAW A DIAGRAM f-HINe

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Aim:

to provide the necessary information to enable a physician to draw the f-HINe diagram of a clinical case stored in a health record.

Abstract:

The elements (Health Issue and evolutions) and rules that are the basis of an f-HINe diagram are illustrated. The 11 steps to be followed to identify the information needed to draw the f-HINe diagram of the clinical history stored in a health record, are presented.

Finally, the evolutions are briefly illustrated in a table.

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For a more detailed presentation of the f-HINe model



A. What is an "f-HINe diagram" and what does it look like

- f-HINe is the acronym for "Friendly Health Issues Network of an Exemplar". By exemplar we mean the story of a single, specific patient and the diagram is "friendly" (friendly) because it uses much simpler symbols and rules than the mathematical model; the model on which the logic of the HIN approach is based is that of Petri nets.
- An f-HINe diagram resembles a concept map, where the rectangles contain the names of Health Issues (HI) and the edges connecting the rectangles represent the "evolution", i.e. the ways in which a health issue changes or gives rise to or contributes to the occurrence of another issue.
- A Health Issue can be a diagnosis or a hypothetical diagnosis, a sign/symptom, a sociocultural condition, a genetic or familial predisposition, the report of a diagnostic test, a physiological process (pregnancy, aging) or pathophysiological (inflammation, infection, mutation, hypo- or hyper- or dysfunction, ...). The meaning is very broad and includes any situation that has influence on health. The diagnostic and therapeutic procedures are NOT represented as such HIN, only the information originating from them is represented as HI.
- There are **eight** evolutions present in the HIN approach:
 1. **worsening e Improvement:** these are similar though opposite evolutions, because the HI remains the same, only its intensity varies.
 2. **recurrence:** the HI recurs several times over time, each episode being interspersed with a period of resolution of the problem (in this is the difference with the cycle, see in n. 7).
 3. **examining in depth:** this is the evolution by which multiple HIs "converge" into another through the diagnostic process. Source HIs are usually clinical information (signs/symptoms/referrals), the target HI is a clinical diagnostic (or hypothesis) HI.

These three evolutions are represented with a continuous edge. This indicates that the source HI "disappears" and "becomes" the target HI. Obviously, symptoms and signs do NOT disappear when we make a diagnosis (maybe ...), but conceptually they are "incorporated" into the "diagnosis" container: the patient is no longer characterized as "patient with fever, cough and dyspnea," but as "patient with bronchopneumonia." The same applies to exacerbation: if a patient with NYHA 2 heart failure worsens and becomes NYHA 3, his NYHA 2 problem no longer "exists"; it has become NYHA 3.

The "disappearance" of the source problem has consequences on the logical-mathematical level of HIN.

4. **complication:** one HI gives rise to another HI that is different in nature. The diversity is related to the site or organ or system (a patient with diabetes complicates with diabetic foot), or to the pathophysiology (a patient with choledochal stones complicates with cholangitis). In current medical parlance, one can say that a choledochal stones aggravates or complicates with cholangitis, as if they were synonymous. As we will see a few lines below, in HIN the logical-mathematical distinction with aggravation is that in complication the HI of origin does not "disappear," but persists active.
5. **cause:** logically-mathematically equivalent to complication, however in a f-HINe uses cause to indicate the relationship between an etiologic agent or risk condition and its effect. This is a "philosophical" choice: we decided to use "cause" only for circumstances in which we really want to emphasize a cause-effect sequence, thus especially for epidemiological and pathophysiological developments. In current medical parlance we may say that a cholangitis "causes" fever, pain, and jaundice, but this corresponds to reifying "cholangitis" as if it were a real object of the world, whereas it is only a label (=diagnosis) that we apply

to a pathophysiological situation of inflammation, infection, obstruction of the VBP. It is the pathophysiological processes that “cause” symptoms and signs or alterations in instrumental and laboratory findings. Physicians “classify” this information and investigate it as a diagnosis (see point 3).

6. **comorbidity-copresence**: the first label refers to the presence of another disease HI that “favors” (=makes more likely) an exacerbation or complication or suggests further investigation in diagnosis. The second term is similar, only HI is not a disease but a risk, predisposing, physiological condition (old age, frailty, disability, poverty, poor health literacy are NOT diseases). This evolution does not reach an HI but-as mentioned a few lines above-an evolution of aggravation/improvement, deepening or complication. This junction is represented with a Branch Node” (see below).

As explained above, evolutions 4 through 6 are drawn dashed, to indicate the active permanence of the origin HI.

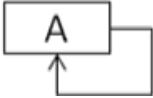

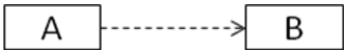
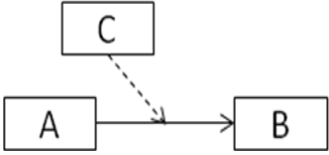
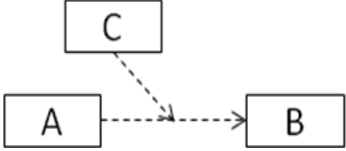
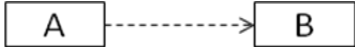

7. **cycle**: is a meandering evolution, indicating an alternation of aggravation and improvement (as occurs, for example, in chronic inflammatory bowel disease or neurodegenerative diseases) or a **positive feedback** loop, in which one HI promotes an aggravation of a second HI and the latter in turn produces an aggravation of the former (diabetes makes an infection more likely and the established infection aggravates glycemic control). The cycle is represented with a double arrow in the two directions, whole or dashed as needed.
8. **Persistence**: is a false evolution, because it only indicates that a certain disease is present over time, without getting worse or better. It has no counterpart on the logical-mathematical level, it is just a graphic device to remind the user-for example-that the primary hypertension “remains,” even though therapy has brought the blood pressure regime back to normal.

The only limitation that the logical-mathematical structure imposes on the freedom to draw an f-HINe as one wishes is that an HI can receive in input ONLY ONE evolution. In order for more other HIs to flow into an HI (as is often the case with symptoms and signs “deepening” toward a diagnosis), a black rhombus symbol, called a “**static branch point**,” is used. It can be reached by many evolutions and many evolutions, even different ones, can emerge from it. The only constraint is that two branch nodes cannot be connected to each other. Numerous graphical examples are available on the HIN project website, at <https://www.healthissuenetwork.org/eng/home>

B. How to draw an f-HINe from a clinical history (in 11 simple steps)

1. **Read** the story twice, the first time out of curiosity to read it, the second time with a pencil in hand, more slowly
2. **Circle** (or underline) terms that may be HI
3. **List separately** the identified HIs and pair them with the times of appearance
4. **Draw** at the base of the diagram plane the arrow of time
5. **Draw** the HIs on the sheet in order of time
6. **Identify** the evolutions and decide which are continuous or dashed arrows
7. **Identify** comorbidities and copresences
8. **Draw** evolutions to join HIs, using branch nodes to avoid multiple inputs
9. **Draw** evolutions of comorbidity/copresence
10. **Check** that each HI has a single evolution (full-stroke or dashed) at the input and a single continuous-stroke evolution at the output
11. **Check** the resulting diagram, trying to "read" it as if it were a story

C. Evolutions in the f-HINe model

	<i>Tipo di evoluzione</i>	<i>Rappresentazione grafica</i>	<i>Esempio</i>
1	<i>Recurrence</i>		An asthmatic crisis (A) recurs several times
2	<ol style="list-style-type: none"> 1. <i>Examining in depth</i> 2. <i>Worsening</i> 3. <i>Improvement or healing</i> 		<ol style="list-style-type: none"> 1. A chest pain (A) is examined in depth in acute coronary syndrome (B) 2. A chronic renal failure of 2nd (A) worsens into 3rd (B) 3. An ulcerative rectocolitis improves and goes into quiescence
3	<i>Complication</i>		A type 2 diabetes mellitus (A) complicates with diabetic retinopathy (B)
4	<i>Worsening with co-presence / co-morbidity</i>		A type 2 diabetes mellitus (A) worsens (B) in the presence of bronchopneumonia (C)
5	<i>Complication with co-presence / co-morbidity</i>		Diverticular disease (A) complicates with digestive hemorrhage (B) in the presence of persistent atrial fibrillation (C)
6	<i>Cause</i>		A neoplastic infiltration (A) causes neuropathic pain (B)
7	<p><i>Cycle:</i></p> <ol style="list-style-type: none"> 1. <i>alternating worsening-improvement</i> 2. <i>positive feedback</i> 		<ol style="list-style-type: none"> 1. A multiple sclerosis alternates between worsening (A) and improvement (B) 2. Following a muscle lesson, pain (A) causes antalgic contracture (B), which in turn causes pain