Classificatory review of ICNP

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prepared for

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by

Peter Sylvest Olsen, physician, consultant
PSO Sundhedsinformatik

Table of contents

1 Introduction

1.1 Background and objectives

A development team under the auspices of the International Council of Nurses (ICN) was given the assignment of drawing up the International Classification for Nursing Practice (ICNP). The Danish Nurses' Organisation (*Dansk Sygeplejeråd*) has asked PSO Sundhedsinformatik to conduct a *classificatory* review of the current beta version of the classification [1].

The **objectives** of conducting this review are to answer questions such as the following:

- What is the structure of the classification and how useful is it for different purposes?
- What are the advantages and disadvantages of the classification in terms of recording and analysing data?
    - Is the classification sufficiently flexible to meet different needs?
    - Is the classification useful in day-to-day work?
    - To what extent does the structure of the classification prevent data from being entered or interpreted in a wrong way, and what are the options for data validation?
- What is the *general* relation to Danish classifications and Danish classification practice, and is it possible to map concepts to and from SKS (*Sundhedsvæsenets Klassifikationssystem* – a classification system established by the Danish National Board of Health) and ICNP to allow international comparison?
- What are the general implications for Danish information systems (including existing electronic medical records systems) if data are to be entered according to ICNP?

The review attempts to answer these questions by examining the structure and contents of ICNP through practical examples, but it does not provide a full analysis on a concept-by-concept basis.

1.2 Delimitation

The review examines only the material described in the next section.

The review does not assess ICNP's *concrete* suitability for describing Danish nursing practice, but many of the *general* classification aspects outlined in this review may support a subsequent evaluation of ICNP from a nursing point of view.

Similarly, the review does not provide any concrete or detailed evaluation of ICNP's relations to the SKS classification system established by the Danish National Board of Health (including the Danish treatment classification and the Danish version of WHO's classification of diagnoses), but it does, however, include general considerations and examples in respect of these relations, and they may subsequently form part of such an evaluation.

1.3 Material used

The review evaluates the beta version of ICNP (the International Classification for Nursing Practice, Beta, ICN 1999). In addition to the original classification in English, supplementary material includes three ring binders containing the Danish translation: *Sygeplejefænomener* (Nursing Phenomena), *Sygeplejehandlinger* (Nursing Actions) and *Appendix* (Appendix) [2].

The following comments are made in respect of the beta version of ICNP:

- The objectives and field of application of the classification are described at a very general level only.
- The concrete data recording rules planned are described and illustrated by examples in very few cases only.
- The validation rules, classification tools and application areas proposed for data are not described. The same applies to the mutual relations between the two parts of the classification and between the underlying axes.
- The numerous choices made in establishing a classification are not described.

This makes reviewing difficult, as evaluation must be based on general assumptions of the above-mentioned factors, and these assumptions may subsequently turn out to be false.

According to the introduction of the classification, supplementary material, including technical manuals and instruction material, will be drawn up, but such material was not available at the time of reviewing (February 2001), and ICN's website did not provide any further information to help answer the above questions.

ICNP has been widely commented *outside* the auspices of ICN (one example being the Telenurse project [3]), but this classificatory review does not include reviewing and assessing such literature. Moreover, it is difficult to find out when these articles describe facts about ICNP that are *established* by ICN and when individual persons or project groups *evaluate* the classification and *form ideas* about its future development and use. Yet several of the articles were used as informative background material for the purpose of reviewing the classification.

1.4 Reading instructions

Reading the entire review is advisable, but specific sections can also be selected, while others may be skipped.

Readers are assumed to be in possession of the English beta version of ICNP, either as a printout or as an on-screen Internet version [4]. Note that the Internet version differs from the printed version in a few insignificant respects.

This review does not **refer** to specific *sections* in ICNP, but only to specific *pages*, and reference is then given in brackets, one example being (page 24). Conversely, no reference is made to other *pages* in this review, but only to other *sections*, and reference is then given in square brackets, one example being [section 3.4]. This should make it easy for readers to distinguish between the two different types of reference. **Source references** are listed in chapter 8, and reference is given in square brackets, one example being [3].

2 Criteria for evaluating a classification

The main evaluation criteria used in this review are compliance with the following general requirements (which any classification should meet unless specific conditions exist):

1. **Objectives.** The classification must be able to meet its objectives, and they must be described in detail and also be relevant and adequate.
2. **Specification of requirements.** Meeting given objectives places certain demands on a classification. These demands or requirements must be described and met.
3. **Target group.** The target group must be able to use the classification, and it should therefore be described in great detail. The target group includes persons responsible for recording data according to the classification and those subsequently using these data.
4. **Field of application.** The classification must consistently cover the entire field of application (domain), which should be described in great detail. Accordingly, all relevant concepts within the field of application must be classified at relevant levels.
5. **Exclusiveness.** Individual concepts may not overlap.
6. **Unique definition.** All concepts must be uniquely defined, either directly in the form of an explicit definition or indirectly through their code text and position in the classification.
7. **Combination classes.** A class may not represent the fact that several individually classified concepts occur at the same time. Hence, the word 'and' may not appear in code texts/definitions in this context. Likewise, a class may not represent the fact that one or more of a number of individually classified concepts occur. Hence, the word 'or' may not appear in code texts/definitions in this context. Such combination classes are not unique and would result in incorrect counts.
8. **Subdivision.** The classification must be consistently subdivided at any level. Any subordinate concept must have at least one characteristic that distinguishes it from its superordinate concept. When a concept is subdivided, the subordinate concepts must make up the superordinate concept, possibly by the addition of a class such as 'Unspecified' or 'Other'.
9. **Possibility of adding codes.** Subdividing a concept calls for the use of a code structure and subdivision criteria that, to a reasonable extent, ensure the possibility of subsequent inclusion of new subgroups of the concept in question.
10. **Modifiers.** In any multiaxial classification, a code from one axis must not *change* the meaning of a code from another axis. The codes of any code set must thus only *supplement* each other.
11. **Code text.** Any code must be accompanied by a text that is in accordance with specific professional usage. It is crucial that the text can appear 'alone' and that it is easily comprehensible to the target group when used in any

given context within the field of application (in electronic medical records, orders, requisitions, statistics, etc.). Understanding the code text may thus not require that codes appear together with other codes at the same and overlying levels (however, the full definition may depend on these levels).

12. **Codes.** At any given hierarchical level, the concepts of a given axis must consistently be represented by the same number of characters. This would otherwise make aggregation, sorting and ranging difficult, thus making the risk of errors too great. Using both numbers and letters is appropriate, as this increases flexibility, shortens code lengths and improves legibility. The letters 'O' and 'I' should not be used to avoid confusion with the numbers '0' and '1'.
13. **Flexibility.** The classification must be applicable at different levels of detail for the purpose of both recording and analysing data. This requires not only a consistently hierarchical structure, but also the possibility of aggregation. A multiaxial structure also increases flexibility.
14. **Interfaces.** The classification must interface distinctly with other types of classification to be used within the field of application.
15. **Code and validation rules**. These must be simple and adequately described from the start.
16. **Instructions.** Adequate instructions must be available, explaining how the classification is used as well as describing the rules to be met.
17. **Data quality.** The definitions, structure, setup as well as code and validation rules of the classification must, as far as possible, prevent any data from being entered, interpreted or analysed in a wrong way. One condition is that the subdivision criteria and code rules of the classification are simple, systematic and consistent.

To increase applicability and secure high data quality, it is *appropriate* that a given classification meets many other rules, but these are not directly included in this evaluation of ICNP.

3 General aspects

The concept 'classification' has many definitions, and some definitions actually establish that ICNP is not a classification, but this has no practical meaning in this context. Therefore, ICNP may very well be described as a multiaxial classification system.

3.1 Advantages and disadvantages of multiaxial classifications

In comparison with a typical monoaxial classification such as the International Classification of Disease (ICD), a truly multiaxial classification offers a number of **advantages** such as the following:

- **Fewer concepts/codes.** The classification will contain far fewer concepts/codes, which is best illustrated by an example: A total of 100 different nursing actions, which can all occur in 100 different situations, will require the inclusion of 10,000 codes in a monoaxial classification system to cover all possible combinations. A multiaxial system will require only 200 codes: 100 actions and 100 situations.
- **Simpler definitions and text.** All other things being equal, the definitions and text of individual concepts/codes are simpler and shorter as they comprise one characteristic only.
- **Easier development and maintenance.** *On the face of it*, the two first factors make development and maintenance rather easier [however, see section 3.2].
- **Better overview.** *All other things being equal*, the structure and contents of the classification give users a better overview.
- **Higher flexibility.** *Basically*, concepts can freely be chosen from the axes as needed. A multiaxial classification can therefore be used for recording either a specific characteristic or a complex set of characteristics in a given situation.
- **A higher number of analysis possibilities.** A multiaxial classification allows certain types of analysis, which *may* not be possible in a monoaxial classification.

However, multiaxial classifications also entail many **disadvantages** such as the following:

- **More data must be recorded.** When a given situation is to be described, two or more concepts/codes must be entered instead of just one as in a monoaxial system. Therefore, recording is *at least* doubled, which is a huge disadvantage in an already busy working day. Staff members are already complaining about spending too much time on recording data.

- **Poor data quality.** In a multiaxial classification, four factors can easily reduce data quality rather substantially:
    - **Invalid combinations.** Concepts from different axes may easily be combined in a wrong way [see section 3.2]. This problem is significant when data are recorded as a matter of standard procedure, but not so important when research and project data are recorded, because the possibility of instructing a few selected users and checking recorded data thoroughly is better.
    - **Missing combinations.** Users may easily forget to enter concepts from one or more of the axes to be used when describing a given situation.
    - **Inappropriate modifiers.** When several axes are used, their meanings may mutually affect each other in an inappropriate way [see section 3.4].
    - **Inconsistent recording.** High flexibility will often cause data entered by different units/users to vary substantially, meaning that data cannot not be understood correctly and compared with other data.
- **Impediment to analysis.** All four factors mentioned above may cause analysis to become faulty, difficult or impossible. Even though data quality is high, analysing data over several axes (although more options *may* be available) is usually more difficult.
- **Comprehensibility and ambiguity.** The higher the number of concepts/axes used for describing a given situation, the more difficult the meaning of the contents and the more ambiguous the combination of concepts [see section 3.2]. For this reason, multiaxial classifications are, all other things being equal, less suitable for routine communication than are monoaxial classifications.
- **Limited data applicability.** All previous factors may limit data applicability especially in routine recording or may even make the classification practically useless.

There are several ways of reducing, but not eliminating, the disadvantages of multiaxial classifications:

1. **A setup that prevents errors**, including the use of a simple and consistent classification and code structure, a limited number of axes as well as preventing the codes of the individual axes from modifying each other in an inappropriate way.
2. **Tight code rules**, limiting the free combination of concepts from different axes.
3. **Detailed code texts** defining concepts as uniquely as possible. Abbreviated rules for using a given concept may, in certain situations, be specified in a code text, one example being '(only when pregnant)'.
4. **Unique definitions** clearly describing the individual concept and distinguishing it from all other concepts in the classification.

5. **Prompts.** When the user selects a given code in his or her classification tool, a text box will show a definition and also provide rules explaining the use of the code and describing possible combinations.
6. **Validation rules** ensuring that only acceptable combinations of concepts are allowed. This may, however, be rather difficult [see the description in section 3.2].
7. **Providing detailed instructions** to users (both those entering data and those understanding and analysing data).

The beta version of ICNP does not meet items 1, 2, 3 and 4, which are described in detail in the following sections. Any use of prompts and validation rules (items 5 and 6) is not described, but such use implies not only a setup that prevents errors, but also tight code rules (items 1 and 2). The disadvantages of the multiaxial structure are thus likely to be particularly noticeable when ICNP is used, unless substantial changes are made.

When it comes to providing detailed instructions (item 7), the introduction of ICNP mentions that instruction material is being drawn up, but imagining that instructions alone can reduce the disadvantages to an acceptable level is rather unrealistic.

3.2 Number of axes and possible combinations

The current version of ICNP is divided into a Nursing Phenomena part and a Nursing Actions part with a total of sixteen axes containing a maximum of twelve classification levels (the axis being included as the first level). Since the classification describes only one specific field and contains as few as 2,500 concepts, the number of axes and levels is *very large*. By way of comparison, SNOMED, a virtually all-embracing multiaxial classification system, contains about 140,000 codes classified into only twelve axes and a maximum of five levels.

The consequences of the high number of classification levels are described in section 3.6, while the effects of the high number of axes are explained in this and the following sections.

The higher the number of axes in a multiaxial system, the more noticeable the disadvantages of the multiaxial structure described above in section 3.1. ICNP rules (pages VI and VIII) lay down that a *minimum of two axes* must be used for recording phenomena and a *minimum of one axis* for recording actions. However, on the basis of the chosen classification of concepts into axes, it must be assumed that, *on average*, more axes will be needed per instance of data recording, and three to five axes per phenomenon or action are not unrealistic. The axes must have been developed for the purposes of actual use. In the six examples specified in ICNP, one uses five axes per concept, while the remaining five examples use four axes per concept.

As mentioned later [in section 3.6], entering just one single concept/code according to ICNP can be rather difficult and time-consuming, so recording data according to ICNP is therefore likely to be **very time-consuming**.

The problem of **invalid combinations of concepts** also escalates drastically when the number of axes increases. If the level of data quality is to be high, it is necessary to establish rules for acceptable combinations, and the system must accordingly ensure that users always follow the rules when entering data. ICNP does not describe such a set of rules, and no reference is made to the combination problem. Only one rule is specified, and it establishes that each axis must be used only once when a given phenomenon or action is described. Examples of invalid combinations are:

1A.1.1.1.16.3	Dying
1B.37.1.1	Insufficient, to a lesser degree
1C.2.2	Often
1D.2	Chronic
1E.1.2.1	Lower right
1F.4.1	Ear
1G.2.1	Very Great chance of
1H.2.2.2	Community (Collectively)

or:

2A.3.1.4	Shampooing
2B.2.1.1.1.1.1.2.1.3.3.3	Cranial Cavity
2C.1.7.11	Contact Lens
2D.2.2	Pre Partum
2E.4.1.2	Both
2F.1.1.7.1	Forearm
2G.21	Rectal
2H.2.1.1	Family (Distributively)

There is no specific or particularly efficient method of eliminating invalid combinations in multiaxial classifications. To begin with, a number of validation tables can be created, specifying either valid or invalid combinations. However, experience shows that a comprehensive validation table is always likely to contain errors that cause invalid combinations to occur or that, for no obvious reason, limit the user's possibility of describing reality. The explanation is that it may be extremely difficult to determine whether or not a given combination can occur in practice.

Moreover, preparing such a set of validation tables is a huge task in respect of ICNP, as the concepts of the eight axes used in the Nursing Phenomena part can be combined in about 1.6 trillion (1,600,000,000,000) ways, while the Nursing Actions part allows about 1,200 trillion possible combinations. The total number of combinations of phenomena and actions can be calculated by

multiplying the two sets of combinations. The total number of combinations is about 1.9×10^{27}.

The percentage of logically invalid combinations is uncertain, but the number of both valid and invalid combinations will be gigantic in any case. Even if one omits to validate combinations between phenomena and actions and choose to validate only combinations of concepts within the axes of phenomena and actions, validation only by the use of tables is practically impossible due to the vast number of possible combinations. It will – to a certain extent – probably be possible to generalise the rules for combining certain axes or sections of axes, but the system must still be based on a number of very large tables *as well as* a set of complex validation rules. Furthermore, both elements must be maintained every time a new concept is added to the classification.

Besides, establishing rules for *whether* a given combination is acceptable or not is often not enough. The thing is that many combinations may (or must) logically occur only in a given situation, and to achieve sufficiently high data quality, it will therefore often be necessary also to establish rules for *when* a given combination may or must occur. Simple examples are dependence due to sex or age (e.g. systems should not allow users to enter nursing actions in respect of an abortion for an 80-year-old male). Yet there are far more complex situations that must be taken into account in order to achieve high data quality, and examples of this are abundant in, say, the validation rules of the Danish National Hospital Discharge Register (*Landspatientregisteret*) [5].

Such situations would further complicate validation and thus make development more costly. The fact is that establishing rules for acceptable combinations in a general classification browser is not enough; it is also necessary to compare the combinations with other patient data stored at different locations in data recording system databases. Such validation must therefore be incorporated specifically in each data recording system, and this is very expensive.

It should be emphasised that the above-mentioned types of problem occur not only in ICNP, but are also varyingly present in any multiaxial data recording system. However, the high number of axes makes the consumption of time spent on recording data substantially higher and the problems of data quality considerably worse for ICNP than for almost any other multiaxial classification.

3.3 Degree of complexity

As a result of the chosen structure of concepts and their classification into a high number of axes, ICNP allows users to construct rather complex combinations of concepts. On the one hand, this aspect makes ICNP highly flexible and, at least in theory, provides a substantial 'power of expressiveness'. On the

other hand, it also allows combinations virtually similar to picture puzzles that are difficult to understand at best or are ambiguous at worst.

A specific complex combination of concepts may describe a situation very precisely to one user, but it is far from certain that the combination would mean the same to another user. Similarly, a specific phenomenon or a specific action within the rules outlined could frequently be described on the basis of various combinations. Hence, recording easily becomes ambiguous and inconsistent, thus making the use of data for medical records, communication and analysis difficult or impossible.

One of the few rules governing the combination of concepts in ICNP is that any description of phenomena must include one concept from the Focus of Nursing Practice axis and also that any description of actions must include one concept from the Action Type axis. This could induce users to believe that these two axes should be regarded as primary axes, while the other axes are used for supplementing these primary concepts within the fields of phenomena and actions. This would ensure a correct interrelation of individual concepts. This is in fact also the case in the first example on page IV:

Pain
Extreme (to a very high degree)
Intermittent
Right
Foot

In this case, the last four axes relate to the Focus of Nursing Practice concept 'Pain', and the combination is easily understood. (Yet one must wonder how to understand the concept 'Extreme (to a very high degree)', and it is in fact not included in ICNP.)

However, the second example on page IV reveals that the other axes do *not* always relate to the Focus of Nursing Practice concept:

Food Supply
Deficiency
High risk of
Community

In the example, this combination is interpreted as 'High risk of food supply deficiency in the community'. The concept 'High risk of' must logically relate to 'Deficiency', as it is absurd to associate high risk with 'Food Supply'. The axes are apparently able to relate arbitrarily to each other, frequently making it possible for any given combination to be interpreted in several ways, as shown by the following two examples:

1A.1.1.1.2.2.1.1	Hypertension
1B.35.1	Increased
1C.2	Intermittent

Does the patient's hypertension worsen intermittently, *or* has his intermittent hypertension worsened?

1A.1.1.1.15.3	Pregnancy
1B.17.1	Desirable
1C.2.5	Never

Has the woman never been pregnant, but wanted to be, *or* has she never wanted to be pregnant?

More often, the large degree of flexibility will mean that a situation can be described using different combinations of concepts. Reference is again made to the example on page IV. In this case, it must be borne in mind that a nurse would be describing a *phenomenon experienced* (lack of food) and not a complete *sentence*: 'High risk of food supply deficiency in the community', where specific words have already been selected for the phenomenon in question. The problem can thus be expressed using several different combinations of concepts such as:

Food Supply	Food Supply	Famine
Deficiency	Adequacy	
High risk of	Low chance of	High risk of
Community	Community	Community

To this should be added the possibility of using the multitude of synonyms and quasi-synonyms included as *separate* concepts in ICNP. Rather than using the concept 'Deficiency', a nurse could very well describe a situation of food deficiency by combining 'Food Supply' with, say, one of the following concepts from the Judgement axis:

Decreased
Disrupted
Disturbed
Dysfunctional
Insufficient
Low
Limited

So it is rather difficult to determine what to look for and what to count on for the purpose of analysing data. In fact, it may make data *useless*.

Other examples of different recording options for a given concept are 'Blood Pressure' combined with 'Increased' *or* 'High' instead of 'Hypertension'. Similar examples can easily be found.

What is important in this context is *not* whether ICNP experts can find a solution that determines what combination of concepts to choose in a given situation or how to understand a specific combination of concepts. The pivotal factor is whether nurses, following a brief introduction, are able to recognise and combine concepts in a consistent and unambiguous way, and this may be very doubtful judging from the above-mentioned examples.

3.4 The problem of using modifiers

A **modifier** is a data field that *changes* the meaning of another field rather than simply *supplementing* the meaning in the form of an additional code. Such an effect on fields/concepts cannot be totally avoided, but must be limited as much as possible to achieve adequately high data quality. A typical example of an inappropriate modifier is the use of diagnostic modification when data were reported to the Danish National Hospital Discharge Register in the period from 1978 to 1993. A separate field enabled users to add the following modifiers to a diagnosis:

0 = no modification
1 = observation for
2 = not found
3 = sequelae
4 = antea (previous)
5 = recidivans (recurring)
7 = operatus (previously treated by surgery)

All these modifiers contain important information, but particularly codes 2 and 4 completely change the meaning of a diagnosis in a patient's current medical records. Understanding the diagnosis correctly thus depends on all data users *always* assessing the two fields at the same time. During the validity period of this diagnostic modification, thousands of diagnoses were queried from the Danish National Hospital Discharge Register, but only few of these took such modification into account, and many counts were therefore incorrect. Similar examples are abundant, and the conclusion must be that the use of modifiers is very likely to result in wrong analysis.

It is easy to spot the problem in the example of diagnostic modification. The risk of errors is often not so conspicuous when other modifier types are used, but it may still be high. There are several methods of avoiding the problem of using modifiers [6], but they will not be discussed in this review.

Not only does ICNP entail a *risk* of modifier problems, the Nursing Phenomena part of the classification is based directly on the use of a high number of modifiers. According to ICNP rules (see page IV), a concept from the Focus of Nursing Practice axis must always be combined with a concept from either the Judgement or Likelihood axis, which both contain many modifiers such as:

1B.1.2 No
1B.2.2 Not Achieved
1B.2.1.1 Achieved, to a lesser degree
1G.1.5 Very low risk of
1G.2.5 Very low chance of

The two first concepts are pure negations, while the third concept changes the *degree* of the phenomenon. The last two concepts specify that the phenomenon is *not* present, but that there is a likelihood that it may subsequently occur. The above concepts can also be combined with the Frequency concept '1C.2.5 Never'.

The occurrence of these strongly modifying concepts prevents any analysis of concepts of the Focus of Nursing Practice axis on an isolated basis, even though such a form of 'aggregation' is one of the potential advantages of a multiaxial classification. Moreover, as previously mentioned, experience shows that such modifiers will frequently give rise to misunderstandings in communication and wrong data analysis.

In addition, many of the modifying concepts are placed in the structure in such a way that it renders hierarchical aggregation impossible. For example, the superordinate concept of '1B.32.2 Not High' is '1B.32 High', while that of '1B.12.2 Not Deficient' is '1B.12 Deficiency'. This is rather illogical and very inappropriate.

The Nursing Actions part of ICNP also includes modifiers, but they are of a different nature, and the risk of misunderstanding and wrong analysis is somewhat lower. Concepts from the Target and Means axes can thus be used for describing a variety of means that are not necessarily applied, but used only as a target for instruction. One example could be combining the concept '2B.2.1.2.14.9 Injection' with one of the following concepts:

2A.2.2.3 Giving
2A.5.1.1 Instructing
2A.2.1.1.1 Planning

It is thus not possible to count the number of 'Injections' without taking the Actions Type axis into account. This problem exists in any multiaxial classification, but the fact that the Actions Type axis is of a very general nature accentuates the problem in ICNP. Therefore, the action in question is represented by one of the other axes, but this axis can not be analysed separately.

3.5 Definition of concepts and their hierarchical position

Generally speaking, many concepts in a classification will be adequately defined exclusively by their code text and position in the hierarchy of the classification in question, but a considerable number of concepts usually also leave users in doubt.

It is therefore very commendable that the development team behind ICNP decided to define the vast majority of concepts in the *Nursing Phenomena* part of the classification. This task is both difficult and time-consuming and unfortunately performed only by a few classification developers. It is a pity that this sound principle is used only to a limited extent in the Nursing Actions part of ICNP, where clear definitions are needed as well.

However, it must also be added that many of the ICNP concept definitions are indeed open to discussion from a health professional point of view, and a rather high number of definitions are incomprehensible, ambiguous, illogical or directly wrong. Below are a few examples:

- **1A.1.1.1.13.18.4 Coma** is defined as follows: 'Coma is a type of Consciousness with the specific characteristics: Deep unconsciousness without physiological responses including pain responses.' How can consciousness be characterised by deep *un*consciousness? By the way, a comatose patient does have physiological responses.
- **1A.1.1.1.14.1 Infection** is defined as follows: 'Infection is a type of Function of Immune System with the specific characteristics: Invasion of the body by pathogenic microorganisms that reproduce and multiply, causing disease by local cellular injury, secretion of toxin or antigen-antibody reaction.' An infection is not a function of the immune system.
- **1A.1.1.1.15.1.1.3 Menopause** is defined as follows: 'Menopause is a type of Menstruating with the specific characteristics: Commencement of the female reproductive ability, climacteric, by the end of menstrual cycle and hormone production usually beginning between the age of 45 and 60, but may stop earlier in life due to illness or the surgical removal of the uterus and both ovaries.' The menopause is not a type of menstruation, but indicates the time when the process of menstruation ends. The reproductive ability of females does not *commence*, but *ends* at the time of the menopause.
- **1B.4.1.1 Adequate, to a lesser degree.** What does 'Adequate, to a lesser degree' mean? Is it the same as insufficient and, if so, to what degree?
- **1A.1.1.1.2.2.2.1 Shock** is not a subordinate concept of 'Tissue Perfusion'.
- **1A.1.1.1.10.3.6.2.7 Necrosis** is not a subordinate concept of 'Traumatic Wound', but may be present anywhere in body tissue.
- **1A.1.1.1.12.1.1.8.1 Paresis** is not a subordinate concept of 'Paralysis'.
- **1A.1.1.2.2.1.1.9.2 Self Harm** is not a subordinate concept of 'Health Seeking Behaviour'.

- **1A.2.1.2.1 Animal** is defined as follows: 'Animal is a type of Nursing Phenomena of the Biological Environment with the specific characteristics: Living being or organism with the capability of sensation and the power of voluntary motion influencing life and development of human beings.' Is an organism an animal only if it affects human life and evolution?

Concept definitions are closely related to the chosen subdivision into superordinate and subordinate concepts in the classification, and many of the definitional problems in ICNP are, as demonstrated above, in fact related to the choice of hierarchy. The following example illustrates both this aspect and the frequent occurrence of concepts that (seemingly) have more than one classification. The term 'Tissue' is thus the only code text for the following codes (the nearest supergroup is specified after the code text):

1A.1.1.1.10.3 Tissue (supergroup: Integument)
1F.18.4 Tissue (supergroup: Body Site)
2B.2.1.1.1.1.2.1.18.4 Tissue (supergroup: Body Part)
2B.2.1.1.1.1.2.2.12 Tissue (supergroup: Non Body Part)
2F.1.18.4 Tissue (supergroup: Body Site)

In these examples, the same code text is used for five different codes, and it is also part of three different hierarchies. The term 'Tissue' is thus used for at least three different concepts, which is highly inappropriate. Furthermore, 'Tissue' cannot be a subgroup of 'Integument' (skin and subcutis) as tissue is present elsewhere, for example in the form of liver and brain tissue. It is also difficult to understand that 'Tissue' can be both a 'Body Part' and a 'Non Body Part'. The fact that body parts may be separated from the body can be represented in other ways that do not easily give rise to misunderstanding.

Many definitions are also extremely lengthy and rather illegible or incomprehensible such as this definition on page 33:

'1A.1.1.1.13.1 Pain
Pain is a type of Sensation with the specific characteristics: Increase in sensory sensation from parts of body usually accompanied by subjective experience of severe suffering, facial mask of pain, eyes appear dull and lustreless, beaten look, fixed or scattered facial movement, grimace, alteration in muscle tone, ranging from listlessness to rigidity, self-protective behaviour, narrowed focus of attention, altered time perception, withdrawal from social contact, impaired thought process, distraction behaviour marked by moaning, crying, pacing, restlessness seeking out of other people or activities; pain sensations are related to duration of pain; sudden onset of pain sensations associated with acute tissue damage is marked by automatic responses such as rise in blood pressure, pulse, respiration, sweating, cold sweat, piloerection, paleness accompanied by muscle tension, loss of appetite and anxiety; acute pain sensations are self-limited and function as a protective mechanism to induce the suf-

> ferer to move or withdraw from source of pain to limit further damage, acute pain is usually reported as intensive sharp sense of cutting, shooting or torturing pain; ongoing constantly recurring pain sensations are not accompanied by automatic responses; chronic pain is usually reported as a dull, hurting, aching, frightful or unbearable pain sensation associated with sleep difficulties, irritability, depression isolation, hopelessness and helplessness.'

This text is more like a rather difficult textbook section than a unique and clear definition providing guidance to a nurse who is about to enter data.

Other examples of definitional problems or errors are included in chapter 4 (under the respective axes). However, it must be pointed out that ICNP is reviewed only on a spot check basis, so the examples do not give a complete picture of the definitional problems. Also, definitions are not evaluated from a nursing point of view, and this could give rise to further discussion.

3.6 Classification levels and code structure

The number of classification levels differs in the individual ICNP axes, but about 215 concepts (9%) have ten levels or more, which is seldom seen in classifications. The high number of levels makes working with the concepts rather difficult.

For example, try locating the nursing phenomenon 'Contraceptive use' using the Telenurse browser [7] without searching for the concept in the printed version of ICNP first. This requires making a minimum of eleven choices down through the hierarchy, but choosing the right entry at all levels is actually not so easy due to the specific subdivision into different concepts. The same problem applies to many other concepts. So choosing just one ICNP concept may be a rather time-consuming task.

The code for 'Contraceptive use' shows that the concept is placed at the twelfth hierarchical level:

ICNP:	1A.1.1.2.2.1.1.9.1.1.1.1	Contraceptive Use
SKS:	DZ30	Svangerskabsforebyggelse [contraception]

The similar concept in the Danish SKS classification system, which uses up to seven levels, is shown for comparison purposes. The difference is not always as distinct as in this example, but it is clear that the high number of levels in ICNP is a *choice* made by the development team – not a conceptual requirement. Practically, the four characters of the SKS code are undeniably rather easier to comprehend and enter than the 24 characters of the ICNP code.

Another example is:

ICNP:	2B.2.1.1.1.1.1.2.1.13.1.1	Nail of Finger
SNOMED:	T-01614	Fingernail

SNOMED contains more than 12,000 topographical concepts in a six-character structure (codes can be unhyphened) against an approximate number of 134 topographical concepts in ICNP.

The code structure of ICNP reflects the hierarchical subdivision of the classification, but in a rather striking way. It is not uncommon that codes include a hyphen (as used in SNOMED) or a full stop (as used in ICD-10). The purpose of using these symbols is to separate one or more levels at either side of a given symbol to make the code easier to read, but symbols are generally not entered or stored in the database. ICNP uses full stops between every single level. It is highly debatable whether a number of full stops makes code reading easier, but what is worse is that full stops *must* be included when data are entered (see below). Consequently, ICNP codes will include up to 25 characters, nearly doubling the time spent on recording data (which is already burdensome due to the high number of axes and levels).

ICNP's development team will probably point out that users do not *enter* codes, but only *select* concepts in a classification browser. This is quite right in many cases *provided that* users have such a browser installed in their data recording system. A standardised ICNP browser can, however, be used only for this specific classification, and integration with existing data recording systems is usually rather difficult. Furthermore, entering data may be made on paper-based forms, and this type of recording is often used in pilot projects and short-term ad hoc projects. Finally, codes must be entered when searches are performed and analyses are made. Another thing is that codes must not only be presentable but also legible in output data. For these reasons, lengthy codes present a clear problem.

ICNP contains several hundred errors involving too many or too few full stops and spaces. This shows not only how difficult it is to enter codes on the basis of the chosen code structure, but also reveals that proofreading before the release of the ICNP beta version would have been advisable.

But there is a far worse problem in terms of characters. Multiple characters are often used for representing a given classification level, but individual levels very seldom have a *varying* number of characters in a classification. However, in ICNP, multiple levels may be represented by *either* one *or* two characters. The immediate effect is that the full stops cannot be deleted, as shown in this example:

1A.1.1.1.1.1 Ventilation
1A.1.1.1.11 Restoration

Before sorting		When sorted	
Code	**Text**	**Code**	**Text**
2B.2.1.1.1.1.1.1	Neonate	2B.2.1.1.1.1.1.1	Neonate
2B.2.1.1.1.1.1.2	New Born	2B.2.1.1.1.1.1.10	Caregiver
2B.2.1.1.1.1.1.3	Infant	2B.2.1.1.1.1.1.11	Sibling
2B.2.1.1.1.1.1.4	Toddler	2B.2.1.1.1.1.1.12	Sister
2B.2.1.1.1.1.1.5	Preschool Child	2B.2.1.1.1.1.1.13	Brother
2B.2.1.1.1.1.1.6	School Child	2B.2.1.1.1.1.1.14	Parent
2B.2.1.1.1.1.1.7	Adolescence	2B.2.1.1.1.1.1.15	Mother
2B.2.1.1.1.1.1.8	Adult	2B.2.1.1.1.1.1.16	Father
2B.2.1.1.1.1.1.9	Elderly	2B.2.1.1.1.1.1.17	Stepmother
2B.2.1.1.1.1.1.10	Caregiver	2B.2.1.1.1.1.1.18	Stepfather
2B.2.1.1.1.1.1.11	Sibling	2B.2.1.1.1.1.1.19	Grandmother
2B.2.1.1.1.1.1.12	Sister	2B.2.1.1.1.1.1.2	New Born
2B.2.1.1.1.1.1.13	Brother	2B.2.1.1.1.1.1.20	Grandfather
2B.2.1.1.1.1.1.14	Parent	2B.2.1.1.1.1.1.21	Care Provider
2B.2.1.1.1.1.1.15	Mother	2B.2.1.1.1.1.1.22	Patient
2B.2.1.1.1.1.1.16	Father	2B.2.1.1.1.1.1.23	Client
2B.2.1.1.1.1.1.17	Stepmother	2B.2.1.1.1.1.1.24	Spouse
2B.2.1.1.1.1.1.18	Stepfather	2B.2.1.1.1.1.1.25	Marriage
2B.2.1.1.1.1.1.19	Grandmother	2B.2.1.1.1.1.1.26	Childbearing Family
2B.2.1.1.1.1.1.20	Grandfather	2B.2.1.1.1.1.1.27	Expanded Family Unit
2B.2.1.1.1.1.1.21	Care Provider	2B.2.1.1.1.1.1.3	Infant
2B.2.1.1.1.1.1.22	Patient	2B.2.1.1.1.1.1.4	Toddler
2B.2.1.1.1.1.1.23	Client	2B.2.1.1.1.1.1.5	Preschool Child
2B.2.1.1.1.1.1.24	Spouse	2B.2.1.1.1.1.1.6	School Child
2B.2.1.1.1.1.1.25	Marriage	2B.2.1.1.1.1.1.7	Adolescence
2B.2.1.1.1.1.1.26	Childbearing Family	2B.2.1.1.1.1.1.8	Adult
2B.2.1.1.1.1.1.27	Expanded Family Unit	2B.2.1.1.1.1.1.9	Elderly

Tabel 1: Selection of the Target axis illustrating the sorting problems. The first nine concepts in the left-hand side of the table constitute a classification of age, while the remaining concepts make up a classification of social relations. Sorting the codes will mix the two classifications.

If the full stops are deleted, these two codes will be identical. Even when the full stops are left in their positions, the varying number of characters per level, however, has some rather inappropriate consequences:

- **General aggregation is not possible.** Aggregation usually takes place by removing one or more of the characters of the code starting from the right, but this is not possible in ICNP. The reasons are the varying number of characters per level as well as the rather inconsistent grouping into levels. The fact that it is impossible to make simple aggregations is a huge problem in data analysis and data output.
- **Standardised sorting of the classification is impossible.** When alphanumeric text is sorted in a spreadsheet or a database application, text is sorted on a character-by-character basis from left to right. If, for example, a code contains the characters 'A100', that code follows a code containing 'A1',

but precedes a code containing 'A11'. Consequently, the order of entries in ICNP will be incorrect if concepts are sorted by code (see Table 1).

- **Maintaining codes is difficult.** As a result of this sorting problem, new codes cannot be added correctly in ICNP automatically, but must be inserted manually in their right positions. The persons responsible for maintaining classifications will be rather displeased with this fact.
- **Code ranges cannot be used in their normal way.** The code structure prevents users from specifying a code range in the normal way. Using search criteria such as 'From 2B.2.1.1.1.1.1.1 to 2B.2.1.1.1.1.1.9' would include *all* concepts listed in Table 1.

The overall effect is that ICNP cannot be handled and analysed in a database in the same simple way as other classifications are handled and analysed.

These unfortunate consequences could easily have been eliminated. Other classifications *always* use two characters (by inserting 0 before one-digit characters) at levels where two characters are needed. One reason explaining why this problem exists in ICNP could be that the development team used the heading feature of their wordprocessing application to generate the codes. As appears from this section, numbered headings are not suitable for hierarchical coding.

3.7 Code texts

The classification has a total of 2,498 concepts, and 604 concepts/code texts appear two or more times, some even four or six times. The majority of these replications occur as the topographical classification exists in three axes [section 4.1.4] and since a number of remedies are included in two axes [section 4.2.2], but ICNP also contains a substantial number of *other* types of replication such as:

1A.1.1.2.2.1.2.3.2	Cleaning
2A.3.1	Cleaning
1A.1.2.2	Community (Collectively)
1H.2.2.2	Community (Collectively)
2H.2.2.2	Community (Collectively)
1A.1.1.2.1.1.9.2	Endurance
1B.28	Endurance
1A.2.2.1.2.3.1	School
2F.15	School
1A.1.1.1.10.3.5	Ulcer
1F.19.1	Ulcer

1A.2.1.1.1	Water
2B.2.1.2.10.3	Water
1B.19	Disability
2B.2.2.1.9	Disability
2A.3.4.2	Dressing
2B.2.1.2.2.1	Dressing
1B.32	High
1B.32.1	High
1F.17.8.1	Colostomy
2B.2.1.1.1.1.1.2.1.17.8.1	Colostomy
2F.1.17.8.1	Colostomy
2G.22	Colostomy
1F.2.4	Body Tissue
1F.18.4.2	Body Tissue
2B.2.1.1.1.1.1.2.1.2.5	Body Tissue
2B.2.1.1.1.1.1.2.1.18.4.2	Body Tissue
2F.1.2.4	Body Tissue
2F.1.18.4.2	Body Tissue

In these examples, it is impossible to determine whether concepts are *different* concepts with identical code texts or whether they are *identical* concepts classified in various places in ICNP:

- **Different concepts:** It is inappropriate that code texts are identical if the codes represent different concepts. This prevents users from searching alphabetically for a code and will easily result in wrong analysis and misunderstanding when data are generated for output.
- **Identical concepts.** Classifying a concept several times (which is more likely) is inappropriate because data will become inconsistent and incomparable.

Generally speaking, it must be noted that ICNP's code texts are inadequate in the vast majority of cases. A code text does not necessarily have to constitute a complete definition of the concept in question, but classification texts must be comprehensible in isolated terms, as they are often shown *outside* the classification system, for example in medical records, communications and reports. More or less meaningless code texts are also a problem when alphabetical searches are performed in the classification.

3.8 Measuring outcome

'Nursing Outcome' is defined on page V as follows:

> 'The measure or status of a nursing diagnosis at points of time after a nursing intervention.
>
> To further explain, nursing outcomes are the assumed result of nursing interventions measured over time as changes effected in nursing diagnoses.'

The 'Nursing Outcome Classification' of ICNP is not a classification, but a method whose purposes are:

> 'to begin to identify and distinguish the unique contributions of nursing within this complex view of health care outcomes.'

Briefly, the method establishes that 'outcome' is measured as the difference between the 'degree' of a nursing diagnosis *before* and the 'degree' of that nursing diagnosis *after* a given nursing action (see the figure on page V-VI). It is a condition that the degree (of severity) of the diagnosis is expressed in terms of concepts from the Judgement or Likelihood axis. However, this method entails two significant problems.

First, a patient will usually have been the object of various actions from both nurses and other professional staff during the period between the two nursing diagnoses, and the condition may also have changed as a result of its natural course. So it cannot be concluded that any difference observed between the degrees of two nursing diagnoses is the outcome of a specific nursing action, although it may seem so. The fact that one situation happens after another does not necessarily mean that the first situation is the direct cause of the following situation. It is therefore widely recognised that conclusions in respect of treatment and nursing outcomes must be based on controlled clinical trials.

Second, the applicability of the subjective evaluation ranges included in the Judgement and Likelihood axes is rather questionable [see sections 4.1.2 and 4.1.5 for further information].

The conclusion is therefore that the 'outcome' of a given nursing action *cannot* be measured on the basis of the method outlined in ICNP.

3.9 Maintaining the classification

Changes in public health services may, over time, render it necessary to draw up completely new versions of a classification involving modifications in struc-

ture and code numbers, but this should take place only at long intervals as data are generally incomparable across version shifts. Experience shows that, in terms of comparability, shifting to another version largely corresponds to switching to an entirely new classification, and, as mentioned in section 5.2, mapping concepts to and from different classifications is usually not possible.

For this reason, the structure and numbering system of a classification must allow for the inclusion of new concepts on an *ongoing* basis in *relevant* places in the classification as required. It is inadequate that new codes are added to a supplementary list, as these will not be located when systematic searches are performed in the classification. Furthermore, concepts added outside the relevant classification will not be included when data are aggregated.

Maintaining the classification is possible by taking these measures:

- **Reservation of extra space.** When first establishing a classification, developers must, as a rule of thumb, use only two-thirds of the codes available at any given level. If this is insufficient:
    - Use both numbers and letters, resulting in a total of 34 options at any level (the letters 'O' and 'I' should not be used).
    - Use another hierarchical structure (adding relevant superordinate concepts).
    - Use two-character levels.
- **Appropriate classification.** Avoid using any specific order at a given level (such as alphabetising data).
- **History.** Each code must have a starting date and an ending date (blank for valid codes). It is possible to open and close codes without reducing data quality and data applicability only if these dates are used *correctly* in data recording systems and in data analysis. This method has been routinely used in all official Danish classifications since the end of the 1970s, but any further description of the method falls outside the scope of this review.

Reserving extra space and using an appropriate classification system are methods not used in ICNP (see the description in chapter 4), and this situation can be changed only by restructuring and renumbering large parts of the classification. Hence, in its current version, ICNP *cannot* be maintained properly, although (as demonstrated in chapter 4) this is highly needed. Handling history is not described in the ICNP material.

Moreover, updating ICNP promptly requires setting up a permanent **secretariat** whose task would be to create new codes *immediately* on the basis of an established set of rules. The ICNP material does not describe the establishment of such a secretariat, and making a secretariat operate efficiently on an international scale may also be rather difficult because of language problems, the number of interested parties and different national needs. So it may be feared that any decision to include new codes in ICNP (just as with several other in-

ternational classifications) will be made only at meetings that take place at long intervals, and this will not meet local needs.

Furthermore, maintaining multiaxial classifications entails the problem that when creating new codes the persons responsible should also consider the possible combinations of the concepts in questions and adjust validations accordingly. As mentioned in section 3.2, this is very complicated in respect of ICNP.

If a user wants a relevant concept to be included in the classification and if such inclusion does not take place promptly, this will usually have one or more of the following consequences:

- **Poor data quality.** The classification will not reflect local reality, thus making recorded data inaccurate or even wrong. This means that local needs are not met, and users may often decide not to use the classification.
- **Local codes.** Users may also decide to create supplementary codes in their own data recording systems, and they may often overlap and/or replace official codes.
- **Alternative use of codes.** Users frequently use official codes in another way than that intended if codes do not reflect local reality and/or meet the needs of users.

Of course, such consequences will make any comparison impossible, and the problems of maintaining the codes therefore undermine the entire basis of ICNP as an international classification.

4 Specific aspects

The following section comments on specific aspects relating to the individual axes.

4.1 Nursing Phenomena axes

4.1.1 Nursing phenomena – A: Focus of Nursing Practice

The Focus of Nursing Practice axis (page 4) contains many different concept types such as the following:

- **Functions** like 'Respiration', 'Circulation', 'Digestion' and 'Motor Activity'.
- **Causes of patient actions** like 'Hallucination', 'Fear' and 'Trauma Reaction'.
- **Patient actions** like 'Self Care: Feeding', 'Self Medication', 'Home Maintenance' and 'Aggression'.
- **Natural phenomena and situations made by nature** like 'Hurricane', 'Cold Weather' and 'Domestic Animal'.
- **Situations and conditions made by man** like 'Railway', 'Commercial Building', 'Transportation Service', 'Industrial Conflict' and 'Militant Action'.

An inclusion of the last two groups makes the definition of 'nursing phenomenon' *very* wide.

The first part of the classification, describing functions, seems unsystematic. One particular reason is that several different concept types are classified as subtypes of individual physiological functions, although logically they are functional *disorders* or consequences of such disorders:

- **Symptoms and diagnoses** like 'Dyspnea', 'Hypertension', 'Arrhythmia', 'Fever', 'Urinary Retention', 'Heat Stroke', 'Overweight', 'Kwashiorkor', 'Acne', 'Infection', 'Frost Bite', 'Fracture', 'Senile Tremor' and 'Migraine'. The classification contains many symptoms, but only a limited number of diagnoses.
- **Pato-anatomical concepts** like 'Hematoma', 'Necrosis', 'Scar Tissue' and 'Eczema'.
- **Topographical concepts** like 'Hair', 'Nail', 'Mammary gland' and 'Mucous Membrane'.

These are probably inadequate classification texts. The names of the individual functions (respiration, blood pressure and secretion) should preferably have

been replaced with text of this form: 'Nursing phenomena relating to…'. The current structure seems illogical and confusing. Moreover, the classification does not contain rules that prevent users from using such superordinate concepts when entering data (this is also the case in both examples on page IV). This allows inconsistent recording of data [see the 'Blood Pressure' example in section 3.3].

Furthermore, the **hierarchical relations** between the concepts are open to discussion or even wrong in some respects [see the examples in section 3.5].

Finally, the **description of nursing** appears very inconsistent and even inadequate in many respects. Some symptoms and diseases are classified, but the vast majority are not, including symptoms/conditions such as cardiac arrest, hyperthyrodism, insulin shock, acute abdomen, uraemia, depression and terminal stage and frequently occurring diseases such as cardiac infarct, allergy (except allergic shock), diabetes, cancer (except cancer pain), arthritis (except rheumatic pain) and epilepsy.

Can nurses do without using such concepts? If a nurse focuses on one of these non-classified conditions or diseases, he or she cannot supplement with one of the approximately 10,000 ICD-10 codes, as these cannot be entered in the same fields as ICNP codes.

4.1.2 Nursing phenomena – B: Judgement

In this axis (page 74), all second-level concepts are modified at the third level according to the following *ranking scale* (defined by the words or terms in the right-hand column):

To a lesser degree	Mild
To some degree	Moderate
To a high degree	Substantial
To a very high degree	Extreme

The concepts listed in the right-hand column are just as relative and undefined as the concepts they define in the left-hand column. The value of entering these strongly subjective concepts is very doubtful, and any use of this ranking scale for measuring outcome corresponds to selling elastics by the metre. This should be seen in the light of the fact that any concept from the Focus of Nursing Practice axis *must* be combined with a concept from either the Judgement or Likelihood axis and also that ICNP's outcome concept is based on modification of these degrees [see section 3.8].

In addition, the Judgement axis classifies several **synonyms** and **quasi-synonyms** as separate concepts, thus making recorded data inconsistent. Examples are:

1B.36.2 Not Ineffective	1B.26.1 Effective
1B.37.1 Insufficient	1B.4.2 Not Adequate
1B.37.1 Insufficient	1B.12.1 Deficient

As previously mentioned, using **negations** (as in the first example) will prevent any aggregation of a concept to the second level. The reason is that, in ICNP, the superordinate concept of 'Not Ineffective' is 'Ineffective', which is illogical and clearly contrary to usual classification practice.

Finally, it is odd that the classification does not contain the concept 'Normal'. Consequently, it is not possible to combine phenomena such as 'Pregnancy', 'Growth' and 'Food Intake' with 'Normal'.

4.1.3 Nursing phenomena – C: Frequency

In this axis (page 116), an attempt is made to define some commonly used frequency concepts by fixing a number of times per time interval:

1C.1 Continuous		
1C.2 Intermittent		
1C.2.1 Very often:	>9	times
1C.2.2 Often:	7-9	times
1C.2.3 Sometimes:	4-6	times
1C.2.4 Rarely:	3-5	times
1C.2.4 Very rarely:	1-2	times
1C.2.5 Never	0	times

No time interval is specified, suggesting that definitions must be used for all time intervals (such as per minute, hour, day or week). Unfortunately, ICNP does not allow users to enter the *time interval* used in a given situation. Furthermore, there are many examples where the fixed number of times is inconsistent with the general meaning of the concepts, irrespective of the unit of time chosen.

If, for example, an epileptic's frequency of seizures is given on per-minute, per-hour, per-day, per-week or per-month basis, then a rate of nine is indeed 'Very often', but a rate of one would, on the basis of the same units of time, not be 'Very rarely'. If the frequency of seizures is given on a per-year basis, a rate of nine is not 'Very often', while a rate of one may be considered 'Very rarely'.

Irrespective of almost any time interval or phenomenon chosen, either end of the range would be wrong in relation to normal usage. This is a fact whether one chooses common functions or events such as eating, urination, defecation, menstruation and marital quarrels or pathological phenomena such as extrasystole, renal calculus, fainting, coughing attacks, dyspepsia and urinary tract infections. Try using other concepts and units of time.

It is simply not possible to *establish* the meaning of commonly used, relative concepts in this way. Besides, the frequency 'Never' cannot be regarded as being intermittent, and the concept is also an inappropriate modifier. So only the two superordinate concepts, 'Continuous' and 'Intermittent', can be used in this axis.

4.1.4 Nursing phenomena – F: Body Site

The same classification of 'Body Site' is specified in three axes: the Nursing Phenomena axis F (Body Site) on page 124, the Nursing Actions axis B (Target – Body Parts) on page 159 and the Nursing Actions axis F (Location – Body Sites) on page 184. The concepts are the same, the structure is identical, and the same reference is given to SNOMED codes, but the three sets of codes differ as shown in this example:

1F.18.4.2 Body Tissue
2B.2.1.1.1.1.1.2.1.18.4.2 Body Tissue
2F.1.18.4.2 Body Tissue

This type of replication is inappropriate because it is very likely to result in inconsistent data recording. Maintenance work is also trebled.

To arrange entries in alphabetic order, the complete classification is normally sorted by code text. Therefore, it is rather odd that, halfway through ICNP's systematic classification hierarchy, the development team suddenly starts to subdivide topographical concepts alphabetically. Yet topographical concepts suggest a systematic classification (such as the one used in SNOMED). Alphabetisation has several very inappropriate consequences:

- **Illogical superordinate concepts.** The superordinate concept of 1F.5.3 'Finger' is 1F.5 'F' and not, say, 'Hand' or 'Upper Extremity'. This is not logical.
- **Translation problems.** When 'Jaw' is translated into another language, the translated concept will still have 'J' as its superordinate concept. This will eliminate the already very doubtful advantages of alphabetisation inside a systematic hierarchy, and the classification will be totally incomprehensible to users.
- **Maintenance problems.** It is not possible to extend the classification without breaking the alphabetisation hierarchy, since concepts alphabetised are consecutively numbered. Also, no space is reserved for the letter 'D', which is inappropriate, since recording entries such as diaphragma, discus intervertebralis, ductus choledocus, ductus deferens, duodenum and dura mater will thus not be possible.
- **Aggregation is not possible.** Aggregating a topographical classification is only natural for many purposes.

Finally, the topographical classification used in ICNP must be characterised as being inconsistent and incomplete. Large organs such as heart and lung are included together with details like finger nail, while organs such as liver, gall-bladder, pancreas, kidney, ureter, uterine tube, thyroid, parathyroid, adrenal cortex, spleen, lymphatic system, bone marrow and many others are missing. On account of the factors outlined above, it is not possible to add these organs without having to renumber the entire axis.

On balance, the Body Site axis (and its two replications) must be characterised as useless.

4.1.5 Nursing phenomena – G: Likelihood

The Likelihood axis (page 130) defines a number of relative concepts by specifying a number of probability ranges:

Very high risk of	A probability range of 80-100%
High risk of	A probability range of 60-80%
Some risk of	A probability range of 40-60%
Low risk of	A probability range of 20-40%
Very low risk of	A probability range of 0-20%

The concept 'Chance of' is subdivided in the same way. The problem is, however, that these definitions do not hold true in practice. A 19% risk of cancer would hardly be characterised as 'Very low'. The same goes for risks of the same order associated with, say, serious complications of operation.

Furthermore, methods have been established only in very few circumstances to compute the exact probability of a given outcome, meaning that the probability range will seldom be of any practical use.

If a nurse is to determine the exact probability of a given phenomenon, then he or she has a problem if the rate is 20, 40, 60 or 80, since each of these rates can refer to two different classes. The classes simply overlap.

Finally, the Likelihood axis is a very inappropriate modifier [see section 3.4].

4.2 Nursing Actions axes

4.2.1 Nursing actions – A: Action Type

The main groups of the Action Type axis (page 140) are:

Observing
Managing

Performing
Attending
Informing

According to the rules outlined on page VIII, a nursing action *must* contain one concept from this axis, and it *may* also contain concepts from the other axes in the Nursing Actions part. A small number of the subordinate concepts of these five main groups may make up a separate description of an action, for example 'Combing', 'Bathing' and 'Feeding', but the vast majority cannot appear as individual entries. So it is debatable whether a description of an action consisting *only* of one concept from this axis has any practicable use.

4.2.2 Nursing actions – B: Target

The Target axis (page 158) is defined as follows:

> 'Target is for the purposes of ICNP® defined as the entity that is affected by the nursing action or provides the content of the nursing action.'

So the concept 'Target' is 'the unit that is affected by a nursing action *or* the unit that provides the content of a nursing action'. 'Target' may thus be two completely different items according to this definition, which – in isolated terms – is inappropriate.

Moreover, the first part of the definition may seem difficult to distinguish from the Focus of Nursing Practice axis (Nursing Phenomena), which is defined as 'the area of attention', and codes of the same type are also found in both axes. Why is 'hypovitaminosis' a phenomenon, while 'hypoglycaemia' is a target? Similarly, why is 'anaphylactic shock' a phenomenon, while 'medication allergy' is a target? Diabetes is referred to only as a target. Finally, 'Infection' is classified in both axes. The structure is thus inconsistent.

The second part of the definition seems to overlap the Means axis (Nursing Actions), which is defined as 'the entity used in performing a nursing action'. Accordingly, a total of 256 concepts are included both in the Target and Means axes, but with different codes.

This seemingly definitional overlap should be discussed in detail from a nursing point of view. If concepts are not uniquely defined and easily distinguishable from each other, the consequences will be poor data quality in the form of inconsistent and/or wrong data.

In practice, the Target axis contains many *subaxes* with completely different concept types:

- **Age group.** Reference is made to the range from 2B.2.1.1.1.1.1.1 to 2B.2.1.1.1.1.1.9 on page 158. The difference between 'Neonate' and 'New Born' should be defined more specifically (most would consider the terms synonyms).
- **Family relations or role.** Reference is made to the range from 2B.2.1.1.1.1.1.10 to 2B.2.1.1.1.1.1.27 on page 158. The classification appears to be incomplete in this respect, since concepts such as son, daughter, girlfriend/boyfriend and partner/cohabitant are not included. 'Spouse' is relevant in this context, while 'Marriage' is not, as it is not a subordinate concept of the superordinate concept 'Person'.
- **Topography.** These concepts are replications from the Body Site axis (Nursing Phenomena). This axis is described in section 4.1.4.
- **Technical facilities, equipment, etc.** This subgroup appears to be a group of the Means axis, where most of the concepts are replicated, but with other codes.
- **Conditions** such as physiological measurements, electrolyte imbalances, allergy and diagnoses.
- **Activities.** Subgroups include examinations, treatments, therapy and methods. These subgroups appear to be groups of the Means axis, where most of the concepts are replicated, but with other codes.

Users may very well need to use concepts from two or more of these subaxes when describing nursing actions. However, according to the rules on page VIII, only one concept must be used from the Target axis. This may easily cause users to enter incomplete or inconsistent data, and this is not appropriate.

The Target axis is markedly incomplete in many respects. See page 166 for example:

2B.2.2.1.5 Disease
- 2B.2.2.1.5.1 Infection
- 2B.2.2.1.5.2 Inflammation
- 2B.2.2.1.5.3 Mentally Disturbed
- 2B.2.2.1.5.4 Delirium
- 2B.2.2.1.5.5 Cataract
- 2B.2.2.1.5.6 Diabetes

Surely more than these six diseases/symptoms can be targets of nursing actions. As previously mentioned, a substantial number of symptoms and certain diseases are classified in the Nursing Phenomena part of the classification, but they cannot be entered as targets of specific nursing actions. Another example appears on page 167:

2B.2.3.2 Health Care Service
2B.2.3.2.1 Encounter
2B.2.3.2.1.1 Appointment
2B.2.3.2.1.2 Home Visit
2B.2.3.2.2 Examination
2B.2.3.2.3 Treatments
2B.2.3.2.3.1 Hemodialysis
2B.2.3.2.3.2 Peritoneal Dialysis
2B.2.3.2.3.3 Surgery
2B.2.3.2.3.4 Amputation
2B.2.3.2.3.5 Cesarean Section
2B.2.3.2.3.6 Ostomy
2B.2.3.2.3.7 Tracheotomy

Nurses have many other contacts with patients than 'Appointment' and 'House Call'). The concept 'Examination' has no subdivisions, one possible reason being that a large number of examinations are classified *elsewhere* in ICNP. 'Treatments' is subdivided into a few procedures only, and they have no inter-relation what so ever (by the way, the last four concepts should be subgroups of 'Surgery'). Is such a classification of examinations and treatments adequate for a nurse? This is also one of numerous examples of how the indentation method that is supposed to indicate different levels is used in a wrong way (the current selection contains three different indentation errors).

A third example appears on page 165:

2B.2.1.2.14. Remedy
2B.2.1.2.14.1 Medicine
2B.2.1.2.14.2 Insulin
2B.2.1.2.14.3 Analgesic
2B.2.1.2.14.4 Anesthesia
2B.2.1.2.14.5 Antibiotic
2B.2.1.2.14.6 Vitamin B12
2B.2.1.2.14.7 Solution
2B.2.1.2.14.8 Dialysis Solution
2B.2.1.2.14.9 Injection
2B.2.1.2.14.10 Infusion
2B.2.1.2.14.11 Blood
2B.2.1.2.14.12 Blood Product
2B.2.1.2.14.13 Aerosol
2B.2.1.2.14.14 Vaccine
2B.2.1.2.14.15 Sensitizer

Insulin, analgesics, anaesthetics, antibiotics and vitamin B12 are all subgroups of 'Medicine' (at different levels) and are not, as in this example, items ranking at the same level as this concept. And what about all the other types of medication? Injection, infusion and aerosol are simply three out of a rather large num-

ber of methods of administering medicine. Why are only these three methods mentioned in this respect? A number of other methods of administering medicine are included in the Route axis.

Unfortunately, these examples are no exceptions.

4.2.3 Nursing actions – C: Means

The Means axis (page 172) consists of a number of means, of which 256 out of 262 concepts are also classified in the Target axis, but with other codes. This type of replication is inappropriate because it is very likely to result in inconsistent data recording. Maintenance work is also doubled.

For comments on the contents of the Means axis, see the Target axis section.

4.2.4 Nursing actions – F: Location

The Location axis (page 184) consists of two subaxes: Topography and Place. Users may easily need to use concepts from both subaxes when describing nursing actions. However, according to the rules on page VIII, only one concept must be used from each axis.

The topographical classification is a replication of the Body Site axis (Nursing Phenomena) [for a description, see section 4.1.4]. The Place subaxis contains types of departments/wards and other places of nursing. Especially the list of different hospital departments/wards is incomplete:

2F.2	Place
2F.2.1	Diagnostic Department
2F.2.1.1	Radiology Department
2F.2.2	Hospital Ward
2F.2.2.1	Intensive Ward
2F.2.2.2	Emergency Department
2F.2.2.3	Recovery Ward
2F.2.3	Treatment Department
2F.2.3.1	Operation Theater
2F.2.4	Out Patient Department

A general ward should be included as a subordinate concept of 'Hospital Ward'. Similarly, several subtypes should be added for a number of diagnostic and therapeutic departments.

5 Possibilities of comparing data

It appears from the introduction of ICNP that one of the main objectives of the classification is to allow nursing data to be compared. The following sections will look into the possibilities of making data comparable in an appropriate way.

5.1 Basis of comparison

It is easy to observe similarities and dissimilarities between different sets of data, and anything can be compared for that matter. However, the ability to make reliable conclusions on the *causes* of demonstrated differences and to make rational decisions against this background depends greatly on factors such as methods of analysis and data comparability. Making a correct comparison is therefore a very complicated process, but it will not be described in any further detail in this review.

The only comment to be made in this respect is that the following two of a number of conditions must be met for two sets of data to be comparable:

- **Common conceptual model.** For the purposes of this review, a conceptual model is defined as a set of concepts and relations describing a concrete or abstract part of the world. The public health authorities of different countries use very different conceptual models based on entities such as patient contact, period of sickness or a third entity. To allow comparability, data must be structured according to the same type of model and subordinate concepts such as admission, outpatient treatment, visit, ward/department, event and procedure must also have identical definitions.
- **Common classification.** Within a given conceptual model, different classifications can be used for describing concrete events, but making a correct comparison of two sets of data requires that both sets contain descriptions made according to the same classification and strictly observe the definitions and data recording rules specified in that classification.

As ICNP is a classification system only, it will *never* be possible to make a correct comparison only on the basis of ICNP, and no international conceptual model has yet been adopted to supplement ICNP in this respect. This constitutes a significant problem, as the conceptual models used by the public health authorities of different countries differ rather markedly as mentioned above. Individual countries thus define a basic concept such as 'admission' rather differently, but this fact is often ignored. Most international comparisons of health indicators are therefore subject to a rather high degree of uncertainty, and many are simply useless.

In this section, one must therefore make the rather *doubtful* assumption that the parties wanting to compare data meticulously describe the conceptual model that will form the basis of such comparison. Subsequent to this description, the requirements of a common conceptual model and a common classification can *in theory* be met in two ways:

1. **Mapping data.** Users may decide to record data according to their own conceptual model and classification and then map these data to match a common conceptual model and classification.
2. **Recording data according to a common conceptual model and classification.** Users may decide to record data according to a common conceptual model and classification from the outset.

ICNP suggests that both methods can be used, and ICN's website comments on the possibility of mapping data by including this question and answer:

> *'If I have been using another nursing classification system, do I have to change?*
>
> No. ICNP® provides a unifying framework into which existing nursing vocabularies can be cross-mapped to enable comparison of nursing data collected using other recognized nursing vocabularies and classifications.'

This idea sounds intriguing, but it is entirely unrealistic, which will appear from the following two sections.

5.2 The concept of mapping

Distinguishing between converting the format of data and mapping concepts is very important:

- **Converting the format**. In this meaning, data are converted from one format into another. For example, there are a large number of different date formats, and users can change from one date format to another without experiencing any major problems. Similarly, measurements or readings can be converted from one unit into another. Converting the format of a concept means changing the *representation* of the concept (such as a date or a unit of length), but the *concept* (the semantic meaning) is not changed.
- **Mapping**. Ideally, the purpose of mapping is to translate one concept from one conceptual system (including a classification) into another concept in another conceptual system. Attempts are thus made to replace one semantic meaning with another similar semantic meaning.

Converting the format seldom entails any problems, whereas mapping is possible only to a very limited extent. The following section describes various aspects of mapping.

Mapping concepts *correctly* back and forth between two conceptual systems requires that concepts are related on a 1:1 basis. In real terms, this means that concepts are completely identical, but they may be termed differently (synonyms). Yet, in practice, two conceptual systems with a 1:1 relation are very rare. If one conceptual system exists in a given area, a new conceptual system is developed only if concepts must be defined in another *new* way. What else would the purpose of developing a new conceptual system be?

Having an N:1 relation (that is, **a hierarchical relation**) will be sufficient when concepts are mapped on a one-way basis. A one-way mapping thus corresponds to an **aggregation**. Although two conceptual systems, A and B, do not relate on an N:1 basis, it may be acceptable to map data from A to B as long as B contains a class of the type 'Other'. However, mapping data will *always* result in a loss of information, which is illustrated by an example in the next section.

Furthermore, the persons responsible for creating a mapping table will often not discover that two concepts are defined and/or used differently in the two conceptual systems, although they have identical terms. Sometimes, differences are recognised, but as they cannot be eliminated, concepts are mapped to achieve the best possible outcome. In both cases, such homonymy entails substantial problems when concepts are mapped, as it results in garbled data.

A **controlled loss of information** may be acceptable for certain purposes. One example could be to aggregate data for managerial purposes. On the other hand, *garbled* data are always unacceptable. It is no excuse that the persons responsible for mapping concepts realise that data will be garbled, while assessing that it will have no significance in a given concrete situation. Patient data are used for many different purposes, and garbled data may, at a later stage, very well give rise to wrong analysis results or decisions that are unpredictable at the time of mapping.

5.3 Examples of mapping problems

Health data may be very complex, and local definitions of concepts vary greatly even within a small homogeneous country like Denmark. This is the case even when the same *terms* are used to refer to phenomena, events and actions, and many working teams have observed these variations when defining a common set of data, for example for a clinical database.

Readers must possess health professional knowledge in order to be able to comprehend most examples of different definitions and subdivisions of health

concepts and the concomitant problems of mapping. So, by way of introduction, the following hypothetical (but certainly realistic) example illustrates the fundamental problems of mapping data. Assume that two departments, A and B, have used different classifications to locate the presence of oesophageal cancer, as shown in Table 2.

Classification A
Cancer in the upper half section
Cancer in the lower half section
Unspecified location

Classification B
Cancer in the upper third section
Cancer in the middle third section
Cancer in the lower third section
Unspecified location

Tabel 2: Two different classifications of oesophageal cancer. This example is purely hypothetical. For an explanation, see the text.

Try mapping the concepts from classification A to classification B. The result is that all concepts must be mapped to the 'Unspecified location' class, causing a considerable loss of information that makes comparison in relation to location impossible. Classes of the 'Unspecified' or 'Other' type are abundant in large classifications (such as classifications of diagnosis and surgery), but they hardly exist in ICNP, so it would not be possible to map concepts in this situation at all.

Now try mapping the concepts from classification B to classification A. It is possible to map 'upper third section' correctly to 'upper half section' and 'lower third section' to 'lower half section'. But the 'middle third section' must be mapped to the 'Unspecified' class (provided that this class exists). The result is not as plain to see as when the concepts are mapped from A to B, as *some* of B's data are mapped correctly, while information is lost for other data. However, data are *substantially* garbled in any case, causing *all* classes to contain a wrong number in respect of department B. The reason is that both the 'upper half section' and the 'lower half section' lack an unknown number of entries from the 'middle third section'. Persons analysing data will easily overlook this fact, especially as 'location' is just one of many variables to be analysed in a clinical database, for example.

Similar examples frequently occur in practice. For example, SNOMED contains the following two concepts:

PA-12102 Oropharyngeal suctioning
PA-12103 Tracheobronchial suctioning

which, incidentally, can be compared with the following two concepts in SKS:

BGME0	Sugning af øvre luftveje [suctioning of upper respiratory tract]
BGME1	Sugning af nedre luftveje [suctioning of lower respiratory tract]

Assume instead that a comparison should be made via ICNP. ICNP contains this concept:

2A.3.1.5	Suctioning

which must be combined with a topographical code. The following concepts are relevant:

2B.2.1.1.1.1.2.1.12.1	Mouth
2B.2.1.1.1.1.2.1.13.6	Nose
2B.2.1.1.1.1.2.1.11.1	Larynx
2B.2.1.1.1.1.2.1.18.7	Trachea
2B.2.1.1.1.1.2.1.2.9	Bronchi
2B.2.1.1.1.1.2.1.3.3.2	Oral Cavity
2B.2.1.1.1.1.2.1.3.3.1	Nasal Cavity
2B.2.1.1.1.1.2.1.3.3.4	Laryngeal Cavity
2B.2.1.1.1.1.2.1.12.3.3	Oral Mucous Membrane
2B.2.1.1.1.1.2.1.12.3.4	Tracheal Mucous Membrane

However, there are three problems:

- Should the topography be classified on the basis of the individual organ, cavity or the mucous membrane? Irrespective of the method chosen, one or more concepts will be missing.
- Pharynx will not be included, irrespective of the classification method chosen.
- Also, only one concept may be used from the Target axis, so it is impossible to describe 'upper respiratory tract' and 'lower respiratory tract' on the basis of ICNP. Furthermore, mapping one instance of suctioning the lower respiratory tract to *three* instances of suctioning larynx, trachea and bronchi, respectively, would also be wrong.

Hence, it is possible to map two common actions such as suctioning the upper and lower respiratory tracts to ICNP from neither SNOMED nor SKS.

Now assume that the nurses of a Danish dialysis department have recorded their nursing actions according to SKS and now want to compare their data with those of a foreign department by mapping the data according to ICNP. The SKS treatment classification contains the following concepts relating to dialysis:

BJFD	Dialysebehandling [dialysis treatment]
BJFD0	Akut dialyse [acute dialysis]
BJFD00	Akut hæmodialyse [acute haemodialysis]
BJFD01	Akut peritonealdialyse [acute peritoneal dialysis]
BJFD2	Kronisk dialyse [chronic dialysis]
BJFD20	Kronisk hæmodialyse [chronic haemodialysis]
BJFD21	Kronisk peritonealdialyse, CAPD [chronic peritoneal dialysis, CAPD]
BJFD22	Kronisk peritonealdialyse IPD [chronic peritoneal dialysis, IPD]
BJFZ	Delprocedurer ved dialysebehandling [subprocedures for dialysis treatment]
BJFZ0	Tilslutning af dialyseapparatur til patient [connecting dialysis equipment to patient]
BJFZ00	Tilslutning af hæmodialyseapparatur til patient [connecting haemodialysis equipment to patient]
BJFZ01	Tilslutning af peritonealdialyseapparatur til patient [connecting peritoneal dialysis equipment to patient]
BJFZ1	Fjernelse af dialyseapparatur fra patient [disconnecting dialysis equipment from patient]
BJFZ10	Fjernelse af hæmodialyseapparatur fra patient [disconnecting haemodialysis equipment from patient]
BJFZ11	Fjernelse af peritonealdialyseapparatur fra patient [disconnecting peritoneal dialysis equipment from patient]
BJFZ5	Procedure vedrørende dialysekateter [procedure for dialysis catheter]
BJFZ50	Skift af hæmodialysekateter [changing haemodialysis catheter]
BJFZ51	Skylning af hæmodialysekateter [flushing haemodialysis catheter]
BJFZ52	Skift af peritonealdialysekateter [changing peritoneal dialysis catheter]
BJFZ53	Skylning af peritonaldialysekateter [flushing peritoneal dialysis catheter]
BJKB	Pædagogiske handlinger i relation til dialyse [instructional actions relating to dialysis]
BJKB0	Oplæring i brug af kronisk peritonealdialyse, CAPD [instructions in using equipment for chronic peritoneal dialysis, CAPD]

BJKB1	Oplæring i brug af maskine til peritonealdialyse [instructions in using equipment for peritoneal dialysis]
BUBA2	Hæmodialysediæt [haemodialysis diet]
BUFC1	Diætvejledning ved dialysebehandling [diet instructions for dialysis treatment]
BUFC10	Initial diætvejledning ved dialyse [initial diet instructions for dialysis]
BUFC11	Opfølgende diætvejledning ved dialyse [follow-up diet instructions for dialysis]

ICNP contains the following concepts containing the term 'dialysis':

2B.2.1.2.14.8	Dialysis Solution
2B.2.3.2.3.1	Hemodialysis
2B.2.3.2.3.2	Peritoneal Dialysis
2C.1.14.8	Dialysis Solution
2C.2.3.1	Hemodialysis
2C.2.3.2	Peritoneal dialysis

These concepts must now be combined with concepts from ICNP's other Nursing Actions axes. Try finding a correct ICNP combination for each SKS concept. *None* of the SKS concepts can be mapped correctly and unambiguously. Most concepts can be mapped, but only at a *considerable* loss of information, and some concepts cannot be mapped at all:

- The concepts 'akut' [acute] and 'kronisk' [chronic] exist in ICNP, but only in the Duration axis (Nursing Phenomena), which cannot be used for describing nursing actions.
- SKS allows users to code the concept 'Akut dialyse' [acute dialysis] without specifying the type of dialysis. Yet this concept is unmappable. Apart from the fact that the concept 'Akut' [acute] does not exist, 'dialyse' [dialysis] may be mapped only to these two subordinate concepts: 'Hemodialysis' and 'Peritoneal Dialysis'. They cannot be used in this respect without data being garbled.
- As regards the concept 'Skylning af hæmodialysekateter' [flushing haemodialysis catheter], 'Skylning' [flushing] is a type of nursing action, while 'Hæmodialysekateter' [haemodialysis catheter] is a target. 'Hæmodialysekateter' does not exist in ICNP, and it is not possible to combine the Target concepts 'Hemodialysis' and 'Catheter', as only one concept can be used from each axis. The same comments can be made in respect of the concepts containing 'dialyseapparatur' [dialysis equipment], 'hæmodialyseapparatur' [haemodialysis equipment] and 'hæmodialysediæt' [haemodialysis diet].

- The concepts 'initial' [initial] and 'opfølgning' [follow-up] do not exist in ICNP.
- What should be done about unmappable concepts? ICNP has no general collection classes.

If nurses want to map the phenomenon 'uraemia', they will find out that this concept does not exist in ICNP. It is not even possible for them to map 'uraemia' to a more unspecific entry such as 'renal insufficiency', as the concept 'renal' is not classified in ICNP.

There are many other examples where a given classification is more or less detailed and/or has a different structure than ICNP. It must be pointed out that the problems are caused not only by the fact that ICNP is incomplete in many respects; the fundamental problem is that different classifications use *different classes*. Any comparison will be subject to uncertainty if only few concepts in a classification cannot be mapped correctly. Once data have been mapped, it will not be possible to see what has been lost in the process.

Note that the concept 'classification' also includes all minor classifications, even 'yes' and 'no' questions. If classification A contains options like 'yes', 'no' and 'don't know' and classification B allows only 'yes' and 'no', mapping data either way will be impossible. The fact is that the concepts of a classification are delimited not only by their own definitions, but also by their relations to other classes. Consequently, users will use 'yes' and 'no' options differently in the two classifications, depending on whether they are allowed to select 'don't know' or not. This is all it takes to make comparability impossible.

5.4 ICNP's potential role in comparisons

These examples as well as practical experience suggest that errors will occur rather frequently when attempts are made to map health concepts, and revealing such mapping errors will often require expert knowledge, cumbersome data analysis and/or case studies.

The consequences are that such concept mappings are unacceptable, as they will reduce data quality and thus also the possibility of analysing and comparing data. If data must be compared using ICNP, there is only one thing to do: all data in the data set must be *recorded* strictly according to ICNP (or possibly according to *truly* hierarchical subdivisions of ICNP's concepts). It is thus completely unrealistic to imagine that ICNP can be used to any greater extent as an intermediary classification for comparing data recorded according to different classifications and/or conceptual models.

However, on the basis of the review of the classification made in chapter 3, it must be concluded that, generally speaking, ICNP is not a suitable tool for routine data recording. For this purpose, the classification is too complex, ambigu-

ous and time-consuming in terms of use. ICNP will, *at best*, be suitable only for recording and comparing data in controlled and well-defined projects and clinical trials. Yet this requires that the development team corrects the high number of inexpediencies (inappropriate design aspects) and errors.

6 Recording data according to ICNP in Denmark

In a few years, the hub of public health service information systems will be electronic patient records. Virtually all patient data will be recorded in or transferred to such systems, and they will work as real or virtual databases for all informatical purposes, including support of patient treatment, quality assurance, management, planning, DRG calculations and reporting to national registers such as the Danish National Hospital Discharge Register, clinical databases and a future Danish National Patient Index (*Nationalt Patientindeks*).

On 20 February 2001, the Danish Ministry of Health, the Danish National Board of Health, the Association of County Councils in Denmark and the Copenhagen Hospital Corporation (*H:S*) sent a joint letter about electronic patient records standardisation [8] to the hospital owners. This letter once again points out that SKS (*Sundhedsvæsenets Klassifikationssystem* – a classification system established by the Danish National Board of Health) must be used for recording structured data in electronic patient records. The hospital owners are thus unlikely to allow nurses to use ICNP in their systems for *routine* data recording to any appreciable extent.

ICNP may, to a limited degree, be used for project and research purposes, but it will require the development of separate systems, as ICNP data cannot be entered and stored in SKS fields because of the difference in code structure and code rules. Moreover, a substantial volume of double entries must be anticipated, since relevant parts of data recorded as a matter of standard procedure are generally unmappable to ICNP [see chapter 5]. Also, the functions of ICNP data recording systems are unlikely to be integratable with other recording features and existing standard operating procedures.

Irrespective of ICNP's suitability for recording data as seen from a classification and nursing point of view, it is thus unlikely that ICNP will be used to any greater extent by Danish public health authorities. It must be pointed out that this conclusion does not include any assessment whether the individual parts of the SKS classification can meet the demand for classifications in the Danish health sector.

7 Overall evaluation

7.1 Meeting the evaluation criteria

This section compares the descriptions in chapters 2, 3, 4, 5 and 6 with the evaluation criteria outlined in chapter 2. The next section describes whether ICNP meets the first criterion, while Table 3 below contains a summary stating whether ICNP meets the remaining evaluation criteria:

General classification requirements	Evaluation of ICNP's beta version
1. Objectives. The classification must be able to meet its objectives, and they must be described in detail and also be relevant and adequate.	See section 7.2.
2. Specification of requirements. Meeting given objectives places certain demands on a classification. These demands or requirements must be described and met.	The classification does not contain any specification of requirements, and the requirements needed to meet the objectives are not fulfilled [see section 7.2].
3. Target group. The target group must be able to use the classification, and it should therefore be described in great detail. The target group includes persons responsible for recording data according to the classification and those subsequently using these data.	The target group is not described explicitly. Due to its huge complexity [see section 3.3], ICNP is considered unsuitable for routine data recording and data analysis in nursing.
4. Field of application. The classification must consistently cover the entire field of application (domain), which should be described in great detail. Accordingly, all relevant concepts within the field of application must be classified at relevant levels.	The field of application is described as nursing phenomena and nursing actions, but the coverage is inconsistent and incomplete [see chapter 4].
5. Exclusiveness. Individual concepts may not overlap.	This criterion is not met [see section 3.7, for example].
6. Unique definition. All concepts must be uniquely defined, either directly in the form of an explicit definition or indirectly through their code text and position in the classification.	This criterion is not met [see section 3.5, for example].
7. Combination classes. A class may not represent the fact that several individually classified concepts occur at the same time. Hence, the word 'and' may not appear in code texts/definitions in this context. Likewise, a class may not represent the fact that one or more of a number of individually classified concepts occur. Hence, the word 'or' may not appear in code texts/definitions in this context. Such combination classes are not unique and would result in incorrect counts.	This criterion is met.

General classification requirements	Evaluation of ICNP's beta version
8. Subdivision. The classification must be consistently subdivided at any level. Any subordinate concept must have at least one characteristic that distinguishes it from its superordinate concept. When a concept is subdivided, the subordinate concepts must make up the superordinate concept, possibly by the addition of a class such as 'Unspecified' or 'Other'.	This criterion is not met [see section 3.5, for example].
9. Possibility of adding codes. Subdividing a concept calls for the use of a code structure and subdivision criteria that, to a reasonable extent, ensure the possibility of subsequent inclusion of new subgroups of the concept in question.	This criterion is not met [see section 3.9]. On the contrary, the classification uses a code structure and a code assignment that, in many places, prevent the addition of new codes [see section 4.1.4, for example].
10. Modifiers. In any multiaxial classification, a code from one axis must not *change* the meaning of a code from another axis. The codes of any code set must thus only *supplement* each other.	This criterion is not met [see section 3.4]. ICNP is in fact based directly on the use of modifiers.
11. Code text. Any code must be accompanied by a text that is in accordance with specific professional usage. It is crucial that the text can appear 'alone' and that it is easily comprehensible to the target group when used in any given context within the field of application (in electronic medical records, orders, requisitions, statistics, etc.). Understanding the code text may thus not require that codes appear together with other codes at the same and overlying levels (however, the full definition may depend on these levels).	This criterion is not met [see section 3.7].
12. Codes. At any given hierarchical level, the concepts of a given axis must consistently be represented by the same number of characters. This would otherwise make aggregation, sorting and ranging difficult, thus making the risk of errors too great. Using both numbers and letters is appropriate, as this increases flexibility, shortens code lengths and improves legibility. The letters 'O' and 'I' should not be used to avoid confusion with the numbers '0' and '1'.	This criterion is not met [see section 3.6].
13. Flexibility. The classification must be applicable at different levels of detail for the purpose of both recording and analysing data. This requires not only a consistently hierarchical structure, but also the possibility of aggregation. A multiaxial structure also increases flexibility.	The high number of axes makes the classification flexible, but the inconsistent subdivisions, the numerous negations and the code structure allow aggregation only to a very limited extent [see chapter 3].

General classification requirements	Evaluation of ICNP's beta version
14. Interfaces. The classification must interface distinctly with other types of classification to be used within the field of application.	This criterion is not met [see sections 4.1.1 and 4.2.2, for example].
15. Code and validation rules. These must be simple and adequately described from the start.	Only few, simple code rules are described in the classification. Achieving high data quality requires the existence of many other code and validation rules [see section 3.2, for example].
16. Instructions. Adequate instructions must be available, explaining how the classification is used as well as describing the rules to be met.	This criterion is not met.
17. Data quality. The definitions, structure, setup as well as code and validation rules of the classification must, as far as possible, prevent any data from being entered, interpreted or analysed in a wrong way. One condition is that the subdivision criteria and code rules of the classification are simple, systematic and consistent.	This criterion is not met [see section 3].

Tabel 3: Evaluations of whether ICNP meets the evaluation criteria.

According to the evaluations outlined in Table 3, the beta version of ICNP does not even remotely meet the fundamental requirements of a contemporary classification. Almost any classification is subject to some errors and inexpediencies. However, considering the fact that the ICNP project was started in 1990, the beta version seems amazingly incomplete, containing a high number of unclear classification points, inexpediencies and errors. One should question not only the organisation of the development project, but also the representation of classification and health informatics expertise in the development team.

7.2 Meeting ICNP's own objectives

The introduction to ICNP states the following objectives (numbers have been added for practical reasons):

> 'The initial objectives of ICNP®, established by ICN and outlined in the Alpha version, were reviewed during the development of the Beta Version. These objectives continue to direct the aims of the ICNP® Programme and include:
>
> 1. To establish a common language for describing nursing practice in order to improve communication among nurses, and between nurses and others;

2. To describe the nursing care of people (individuals, families and communities) in a variety of settings both institutional and non-institutional;
3. To enable comparison of nursing data across clinical populations, settings, geographic areas and time;
4. To demonstrate or project trends in the provision of nursing treatments and care and the allocation of resources to patients according to their needs based on nursing diagnoses;
5. To stimulate nursing research through links to data available in nursing information systems and health information systems;
6. To provide data about nursing practice in order to influence health policy-making.'

These objectives are relevant, but also of a very general nature, and it is rather surprising that no reference is made to the concept 'quality assurance'. As the objective are neither illustrated by example nor specified in more concrete subobjectives, most of them can be interpreted differently. This makes it difficult to evaluate whether they are met or likely to be met in the future.

For the ICNP project to continue, its objectives should preferably be described in concrete, defined and limited terms. One of the explanations for the inexpediencies described in this review is that an attempt has been made to develop ICNP to handle several different and general objectives that, to a considerable extent, place very different or even conflicting demands on the structure, contents, rules, etc., of a classification.

The *general* evaluation is that the high number of inexpediencies and errors *prevent* the beta version of ICNP from meeting any of the objectives mentioned above. Making the objectives more specific than they presently are will, however, make it possible to remove many of the inexpediencies, but this will require *sweeping* changes in both the classification and its set of rules (see descriptions above). *Provided that*

- the high number of inexpediencies and errors are corrected, and
- ICNP is considered suitable from a nursing point of view,

the classificatory evaluation of the six objectives is as follows:

1. **Using ICNP as a common language for communication.** *If* relevant parties agree to accept (some of) ICNP's definitions of concepts, this would, all other things being equal, make nursing communication more unambiguous, no matter whether such communication is verbal or takes place via free text or structured information. Yet the complex and ambiguous structure of ICNP makes it unsuitable as a basis for *structured* electronic communication of patient data in the ordinary treatment of individual patients.
2. **Using ICNP as a descriptive tool.** Properly used, ICNP *may* be a flexible tool to be used in *controlled and well-defined projects and clinical trials*. This requires that ICNP is used directly for recording data [see section 5.4].

But ICNP is generally considered too complex, ambiguous and cumbersome for other routine recording, and it is not possible to integrate data into other data recording systems data at Danish hospitals [see section 6].

3. **Using ICNP for comparison.** Comparing data requires that all data are registered *directly* according to a common classification *and* a conceptual model, since mapping data from one classification (or conceptual model) to another is virtually impossible [see section 5.4]. If two departments record data consistently according to ICNP, these data will be comparable, and the individual department will also be able to compare their own data over time. But since ICNP is generally not suitable as a basis for routine recording [see item 2 above], the classification will be unsuitable for routine recording of, say, quality data. This is a substantial limitation of use.
4. **Using ICNP for projections and resource allocation.** Using the classification for these purposes will be possible only if ICNP is used for routine recording, and, as previously mentioned, ICNP is not suitable for this purpose.
5. **Using ICNP for boosting nursing research.** The flexible structure of ICNP is likely to encourage research in the field of nursing. Using the classification for research analysis will generally require controlled studies, however.
6. **Using ICNP for providing nursing data in order to obtain political influence.** To be used for collecting data that may affect political decisions, a classification must, on the basis of *routine* recording of data, allow users to make structured descriptions, comparisons and projections. ICNP is not suitable for this purpose.

Even if the high number of inexpediencies and errors are corrected *and* ICNP is considered suitable from a nursing point of view, ICNP will meet its own objectives according to this evaluation only to a very limited extent. The only 'solution' to this problem is probably to target ICNP at a few specific purposes (as mentioned above). It appears indirectly from the above items that ICNP could be used as:

- a terminological framework of reference for the nursing profession
- a classification for specific data recording in projects and studies

Moreover, ICNP could perhaps also provide an incentive for and, to some degree, also form the basis of national and regional classification projects, thus possibly reducing some of the tasks to be performed during the first stages of establishing a classification.

However, whether these more modest purposes can justify a continued development of a comprehensive international classification is quite another matter, which this review will not address. This is also the case when it comes to considering whether other existing classification systems (be they national or international) are better capable of meeting the classificatory demands of nurses than ICNP is.

8 Source references

1. ICNP – International Classification for Nursing Practice. ICN 1999.
2. The International Classification for Nursing Practice. ICNP Beta. Three ring binders containing the Danish translation: *Sygeplejefænomener* (Nursing Phenomena), *Sygeplejehandlinger* (Nursing Actions) and *Appendix* (Appendix). Translation by Randi A. Mortensen. November 2000.
3. Http://www.telenurse.net/
4. Http://icn.ch/icnpupdate.htm
5. *Fællesindhold for basisregistrering af sygehuspatienter 2001* (General contents for basic recording of hospital patient data). The Danish National Board of Health, November 2000.
6. *Integration af informationssystemer i sygehusvæsenet i Vejle Amt og Viborg Amt* (Integration of information systems in the hospital services of Vejle and Viborg Counties). Prepared for Vejle and Viborg Counties by PSO Sundhedsinformatik, June 2000.
7. Http://www.telenurse.net/Sider/DIHNRMain.html
8. *Principper for standardisering og udbredelse af elektroniske patientjournaler* (Principles for standardisation and use of electronic patient records). The Danish Ministry of Health, the Danish National Board of Health, the Association of County Councils in Denmark and the Copenhagen Hospital Corporation. Letter of 20 February 2001.