Special Article

On the design of anaesthesia record forms

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The purpose of this report is to develop a rational approach to the design of anaesthesia record forms. The history of anaesthesia record forms was reviewed. A logical approach to the design of an anaesthesia record was developed. The theoretical ideal anaesthetic record was contemplated and criteria were developed for the selection of items to be included in or excluded from the record. Principles were outlined which lead to logical organization of information on the form, improved ergonomics of data entry, and ready access to entered information. A desktop publishing system was used to execute quickly numerous form artwork revision cycles and iteratively converge on a complete design. This approach has resulted in the development and production of a new anaesthesia record for our institution. The record was well accepted by our colleagues. The rationale that has been developed is presented in the hope that it will be useful to others in the process of designing anaesthesia records for their institutions.

Ce rapport propose une démarche rationelle orientée vers la conception du dossier d'anesthésie. L'historique des dossiers d'anesthésie a été revue et une approche logique élaborée pour la conception d'un modèle. Un dossier théorique idéal a été préparé avec les critères nécessaires à la sélection des items à inclure ou à exclure. Des principes sont décrits pour faciliter sur le dossier l'organisation logique des renseignements, l'amélioration de l'ergonomie pour l'entrée des données et un accès rapide à cette information. Un système d'éditique a été utilisé pour réviser rapidement plusieurs maquettes et progresser vers un modèle complet. Cette approche a permis le développement d'un nouveau dossier d'anesthésie pour notre institution. Ce dossier a été bien accepté par nos collègues. La méthode utilisée est présentée dans l'espoir qu'elle sera utile à ceux qui projettent la conception d'un dossier d'anesthésie pour leur institution.

Key words
RECORDS, ANAESTHESIA;
STATISTICS: anaesthetic.

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The anaesthesia record is an integral part of the everyday practice of anaesthesia. It is used to document the pre-operative anaesthetic assessment, the actions and interventions of the anaesthetist, the patient's vital signs throughout surgery, and important events or complications. The anaesthesia record makes whoever is responsible for post-operative management aware of important intra-operative events, and it may help anaesthetists manage the patient during future operations. Information from the anaesthesia record is used for quality assurance purposes[1] and as a source of data for research. Recorded information also serves to protect the anaesthetist if any legal action arises from the care of the patient.

Documentation should proceed in a simple and intuitive manner. The form should be easy to read and unambiguous. The number and variety of items appearing on the record should be minimized and rationalized, to present a neat and logical organization on the page, and to reduce the effort of complying with required documentation.

History of the anaesthesia record

> "At first, those in the surgery felt that I was delaying the work when I took the blood pressure on each patient and demanded the chart before starting the anaesthetic. However, the surgeons politely consented to pamper me." – John S. Lundy, Seattle, Washington, 1924.[2]

Formal anaesthesia records were first used in 1894, at the Massachusetts General Hospital. Two Harvard medical students, Harvey Cushing and Amory Codman, recorded pulse rate, respiration, depth of anaesthesia, and the amount of ether given, believing that these "ether

charts" would lead to safer anaesthesia. Codman later stated that the idea of keeping charts was suggested to him by his chief, F.B. Harrington.[3] In 1902, Cushing added blood pressure to the anaesthesia record.[4]

The Cushing-Codman ether chart was adopted in other centres. In a 1901 paper entitled "Remarks on the administration of anaesthetics, with special reference to the technique of chloroform administration" delivered to the Alabama State Medical Society, B.B. Rogan, a physician from Selma, Alabama said:

> "I have recently adopted the ether chart, devised by Dr. Cushing of Johns Hopkins Hospital. This is nothing more than a chart very similar to the ordinary temperature chart for recording pulse and respiration at intervals of five minutes during the operation. It undoubtedly stimulates the anaesthetist to give closer attention to his patient, and he can inform the operator, at any time, as to the condition of the patient.
>
> "I believe that nothing so trains a person to become skilled in the administration of anaesthetics as the routine employment of charts."[5]

Anaesthesia records became more common in the following two decades. In a 1922 paper to the McGill Medical Society, Harold Griffith stated:

> "Following the plan of many specialists in anaesthesia I have found it of great service to keep a chart showing graphically the blood pressure, pulse, and respiration, and correlating these conditions with the various stages of the operation ... Many of the larger hospitals have their own printed "Anaesthesia Record", but a satisfactory form may easily be improvised, as has been done here, from an ordinary Temperature Chart."[6]

Keeping accurate records may have helped to raise the status of the specialty of anaesthesia. John S. Lundy, in the 1924 paper, stated:

> "In a little over a year there are now more men in Seattle giving nitrous oxide with maximum oxygen and minimum ether and keeping a complete record of blood pressure, pulse rate and respiratory rate, as well as all the procedures in the surgery, than in any other city I know of. These men are depended upon by the surgeon to decide certain questions which, for a long time, he himself has decided, namely: to choose the anesthetic; to sound the warning to close; to begin anti-shock treatment; to choose that treatment; and to advise some of the measures that are to be employed in the post-operative care."

The use of anaesthesia records became widespread, but few attempts were made to standardise them. In 1965, The Subcommittee of the Association of Anaesthetists of Great Britain and Ireland suggested a standard anaesthesia form for use by anaesthetists who worked in hospitals where there were no existing charts. The proposed chart was colour coded, had a grid with a time base for recording vital functions and space for the post-operative recovery period.

In 1976, a report on anaesthesia records in Great Britain and Ireland[7] recommended that:

1 detailed records be kept of the peri-operative period
2 records be on a colour-coded standardised chart
3 records have a grid with a time base for charting incremental drug dosages and vital signs
4 patient identification data and operative data also be included

In 1988 a survey of 22 different charts used by anaesthetic divisions in the Yorkshire Regional Health Authority found that in many cases the above recommendations were not being followed.[8]

Legal requirements and association guidelines

The legal requirements and guidelines for anaesthesia record design are quite general. For example, the portion of the regulations under the Public Hospitals Act of the Canadian Province of Ontario[9] which apply to anaesthesia records states:

27(5) Where an anaesthetic referred to in subsection (1) or (2) is administered to a patient, the anaesthetist who administers the anaesthetic shall prepare an anaesthetic report with respect to the patient that shows,
- (a) the medications given to the patient in contemplation of anaesthesia;
- (b) the patient airway, circuit and monitors used on the patient;
- (c) the anaesthetic agents used, the methods of administration of the agents and the proportions or concentrations of all agents administered by inhalation to the patient;
- (d) the names, quantities and times of all drugs given by injection to the patient;
- (e) the duration of the anaesthesia on the patient;
- (f) the estimated fluid loss of the patient;
- (g) the quantities and type of all blood products and other fluids administered intravenously to the patient during the operation; and
- (h) the vital signs of the patient before, during and after anaesthesia.

The Guidelines to the Practice of Anaesthesia as recommended by the Canadian Anaesthetists' Society (revised 1993)[10] simply states that:

"Adequate records of the patient's vital signs must be made during the course of an anaesthetic. Every patient receiving general, major regional, or monitored intravenous anaesthesia should have arterial blood pressure and heart rate measured and recorded at least every five minutes, unless clinically impractical. The time, dose and route of administration of all drugs and fluids should be charted on the patient's anaesthetic record. Monitors, equipment and techniques used should also be recorded."

The draft report of The Anaesthesia Liaison Committee of The College of Physicians and Surgeons of Ontario and the Ontario Medical Association for The Practice of Anaesthesia in Ontario, November 1989 (no final report was issued), contained a model anaesthesia record, along with a few recommendations as to what should be recorded on such a document. The report stated that:

"The record will include the pre-operative patient assessment, the intra-operative period, and the condition of the patient immediately post-operatively.

"The Chief of the Department of Anaesthesia must establish policies to ensure that the members of his department complete an anaesthetic record containing this minimum information for each patient.

"Individual anaesthetists may wish to record additional parameters; for example, airway pressure, Apgar, etc.

"Entries on this record must be made during the anaesthetic period in a regular ongoing fashion and blood pressure and heart rate should be measured and recorded every 5 minutes, where practical.

"The anaesthetic record must identify all drugs administered as well as significant anaesthetic interventions carried out by the anaesthetist. Time, dosage and route of administration of all drugs and fluids should be charted clearly.

"Complications and incidents producing patient injury must be recorded."[11]

The peer review recommendations for documentation of anesthesia care from The American Society of Anesthesiologists are as follows:[12]

"Pre-anesthesia evaluation:

(A) Patient interview to review medical, anesthesia and medication history.
(B) Appropriate physical examination.
(C) Review of objective data (e.g., laboratory, electrocardiogram, *x*-ray).
(D) Assignment of the American Society of Anaesthesiologists (ASA) physical status.
(E) Formulation and discussion of an anesthesia plan with the patient and/or responsible adult.

"Peri-anesthesia (time-based record of events):

(A) Immediate review prior to initiation of anesthetic procedures:
  1 Patient re-evaluation.
  2 Check of equipment, drugs and gas supply.
(B) Monitoring the patient. (Further clarified under "Standards for Basic Intra-Operative Monitoring."[13] which states that during all anesthetics, the patient's oxygenation, ventilation, circulation and temperature shall be continually evaluated. It then describes standards for measurement of these parameters.)
(C) Amounts of all drugs and agents used, and times given.
(D) The type and amounts of all intravenous fluids used including blood and blood products, and times given.
(E) The technique(s) used.
(F) Unusual events during the anesthesia period.
(G) The status of the patient at the conclusion of the anesthesia."

The present

Existing laws, regulations, and association guidelines, such as those cited above, are very general and leave much latitude in chart design. In an informal survey of anaesthetic charts from hospitals in our region, we observed great variability in chart clarity and in organization for most efficient data entry. Several charts had not been revised for decades. By reviewing the international contributions to any clinical anaesthesia journal, one can readily see that throughout the modern industrialized world the approach to clinical anaesthesia is very similar. It would seem reasonable, therefore, that anaesthetic events could be documented in a more uniform fashion.

It should therefore be possible to develop chart design criteria that lead to precise design specifications, while remaining widely applicable. Consistent use of logical chart design criteria enhance the clarity of the form and optimize the efficiency of data entry. Precise specifications speed up the process of form design or revision.

In our institution the anaesthesia form evolved as a series of overdue revisions, "patched like an old road". Several attempts to revise the form thoroughly lost momentum because users failed to reach agreement on many aspects of the design. Some would argue for inclusion or exclusion of particular items using their own personal rationalizations, but others would not always accept their reasons and priorities. Ultimately we overcame this difficulty when we found that it was easy for users first to agree on general principles and criteria for inclusion and exclusion of items. These, in combination with our hospital's existing written guidelines for the design of medical forms, were then systematically applied to each proposed item or feature.

Our goal was to select a set of pre-printed items which would be adequate to document 90% of anaesthetics performed, and to designate blank areas for recording any other items.

Using a personal computer "desktop publishing system" to produce professional quality draft versions we were able to interview users and revise the form iteratively within short turnaround times. Through more than 55 revisions of the artwork in less than a year, we achieved a much more satisfactory result than would have been possible working with a forms artist and print shop. After the necessary hospital committee approvals were obtained, we arranged for the final printing plate to be made using a high-resolution emulsion side down negative film that was produced by a 1270 dot-per-inch image-setting machine driven by a desktop publishing system. This final step was rapidly and easily done at little additional cost.

By presenting the results of our work, we hope to contribute to the improvement of anaesthetic documentation, and to help others more quickly develop or revise anaesthesia records.

Anaesthesia chart criteria

We prepared the following outline to guide the systematic development of our anaesthesia chart:

1 list all possible items to be recorded
2 list criteria for including items
3 list criteria for excluding items
4 screen list against inclusion and exclusion criteria
5 group related items
6 select best sequence for items in each group
7 select the location of each group on the page
8 choose for each group:
  (a) the space to allocate for the group
  (b) the type of response for each entry
  (c) the density and/or size of each entry
9 draft artwork
10 professional artwork
11 committee approvals
12 production

Conceptually, we considered the anaesthetic chart to be comprised of the following major groups:

1 patient identification
2 medical staff identification
3 patient pre-operative clinical and diagnostic information
4 anaesthesia equipment and technique
5 peri-operative interventions
6 patient physiological status and responses to interventions during the procedure
7 immediate post-operative condition

Patient demographic data are commonly imprinted from the patient's hospital card. The anaesthetist, assistant anaesthetist, and responsible surgeon(s) should be identified. The anaesthetist need not record the names of other personnel such as nurses or surgical assistants.

The only pre-operative clinical or diagnostic information required on the front of the anaesthesia form is that which needs to be referred to frequently during the course of the anaesthetic (e.g., blood haemoglobin concentration) or is crucial to the conduct of the anaesthetic (e.g., allergies, medications, full stomach, other comments). There are so many relevant medical conditions that we felt we could not justify dedicating space to pre-print any of them.

The anaesthetist typically uses the chart to record all important intraoperative interventions, including administered drugs, monitors, tracheal intubation, type of ventilation, and the patient's physiological status during the procedure. Basic physiological variables are blood pressure, heart rate, and temperature. Whenever pulse oximetry and capnography are available, oxygen saturation and end tidal carbon dioxide tension are part of this basic group. Responses to peripheral nerve stimulation or periodic quantitation of blood loss and urine output during the procedure need only be recorded when noteworthy. There should be a designated area on the chart for recording the status of the patient upon transfer to the post-anaesthetic care unit.

In addition to the pre-printed areas described above, the form should provide a general purpose blank area to be used for recording noteworthy events that occur during the course of anaesthesia. Preferably this area should extend across the full width of the page, near the bottom of the form, and should be at least 4 cm in height to provide adequate space for comments.

Having compiled the list of all possible items to record, we used the following criteria to decide which items to retain on the form:

1 clinical importance
2 information mandated by governing body with jurisdiction
3 medico-legal documentation
4 events requiring frequent documentation

We considered for exclusion items that:

1 do not have a criteria for inclusion
2 have only academic or research interest
3 are of specific sub-specialty interest
4 are recorded elsewhere.

There is a great tendency to include items on an anaesthesia chart "just in case" they "might" be of interest, such as endotracheal tube cuff volume, nasogastric tube placement, or use of respiratory heat exchangers or blood warmers. Such items are usually not recorded, but if recording of such an item is made important by the nature of the case at hand, or if some staff wish to record such

an item regularly, then they can do so in a general purpose blank area. If the majority of the anaesthetist do record such an item, then it can be incorporated into the chart on a priority basis according to criteria set out below. Specific items that are of administrative, academic, or research interest should only be included if they are prospectively identified, appear on the chart for a limited period of time, and all anaesthetists agree to document them.

Items unique to a sub-specialty usually have a frequency of usage too low to warrant a designated fill-in space. For example, a field for the Apgar score is appropriate only on an obstetric anaesthesia chart. Similarly, a field for the length of a pump run belongs only on a cardiac anaesthesia chart. If no distinct sub-specialty obstetric or cardiac anaesthesic form exists, these items can be written in the general purpose blank area of the anaesthesia record.

Information for use by other disciplines such as nursing, administration, or surgery should not be recorded on the anaesthesia chart.

Grouping of items

Having decided which items to include on the form, we next grouped them according to common characteristics:

1 major criteria: the item falls within a major group such as
   (a) patient or medical staff identification
   (b) monitors
   (c) interventions
   (d) physiological status
2 lesser criteria: grouping according to
   (a) similarities of entry type
   (b) frequency of sampling or recording
   (c) other logical association

Filling out the chart is easier when items that require similar entry types are grouped. For example, items with checkboxes should be in one area, items with fill-in-the-blank fields in another, and items to be plotted on a graph in yet another.

Ordering the items in a group

Once groups are designated, the items in each group can be ordered by frequency of recording and by degree of invasiveness, then organised in top-down vertical or left-right horizontal lists.

Finally, the physical "layout" of the chart can be determined after decisions for each group regarding:

1 the space it will occupy on the chart
2 the entry types (checkbox, plotting, numeric or text entry, drawing)
3 density of response of items and the density of the grids used for graphing

Space that is saved by reducing the dimensions of response grids and boxes is limited by excess density which would impair clarity. Important information within dense sections may be missed when reviewing charts. One should also avoid overlap of data, such as when plotting temperature and the systemic arterial, central venous, pulmonary artery, and airway pressures.

Layout

After all the items have been chosen, the type of responses required have been selected, and the space to each item allotted, the items can be laid out on the page according to the following criteria:

1 fit all items on one page
2 lay out the page in portrait (upright) orientation
3 orient all items horizontally (no sideways text)
4 alignment of all grids with the horizontal time axis
5 maintain groupings within demarcated sections

Use of a single page allows all the information to be seen at a glance and keeps it together for photocopying, facsimile transmission, scanning, and microfilm recording. Portrait orientation keeps the anaesthetic record consistent with the rest of the patient chart. Text that is in a different orientation from the overall form layout may be ignored. The grids should extend as far as possible across the sheet to yield the greatest duration of operative time charting per sheet. Demarcated groupings help users locate items efficiently.

Form design criteria

Paper and ink colours

Coloured paper, if used, should be a pale or pastel shade as printing and handwriting contrasts better with the lightly coloured background. Forms with lightly coloured backgrounds are also easier to photocopy, microfilm or digitize to optical disk. "Hot" coloured paper is typically twice the cost of regular coloured paper.

It is least expensive to use black ink. However, blue, brown, green or red ink provides better contrast to typed or handwritten ink. Blue ink reproduces poorly on some photocopying and microfilming machines. Printing costs will be substantially greater if more than one ink colour is used on a page.

Multi-part carbon copy forms

No-carbon-required (NCR) forms are the most convenient format for producing multi-part carbon copies. Industry standard pre-collated papers are cheaper than custom collated forms, but those that are most widely available have white as the top colour. It is the top (original) copy that must be retained in the medical record.

Copies can be held together with glue along one edge

or by a tear-off margin. Glue along an edge is cheaper but users can't remove intermediate copies without disturbing the other copies. A tear-off margin binds the parts together more securely and allows intermediate copies to be removed, but costs significantly more because of the extra step required to make the tear-off perforations.

Margins

If the form is to be hole punched for mounting in the hospital chart then a $^3/_4$-inch (1.9 cm) margin should be allowed along the punched edge. It is most efficient to have holes pre-drilled by the printers.

There should be a minimum of $^1/_4$-inch clearance (6 mm) from all edges because the printing press may not be able to print closer to the edge of the paper, and to avoid difficulties in photocopying or microfilming the document.

Typesetting

There are many well established principles of typesetting and form layout[14,15] that are helpful in the design of any medical form. Some selected aspects that are especially applicable to anaesthesia records are summarized below.

Text

People read fastest and with best comprehension when words and lines of text have distinct shapes. For example, children learn to recognize words by shape before they are able to sound out the letters. Lowercase text has a greater shape content than UPPERCASE. The text we read daily in books, newspapers, etc. is almost entirely in lowercase. Therefore, we suggest that lowercase letters be used throughout the chart.

For emphasis of a single phrase or title, use Word Capitalization or boldface in preference to full uppercase text. Certain terms may optionally be considered to be personal titles and therefore Word Capitalized, e.g., Intern, Resident, Attending Physician.

Oblique or italic text tend to slow readers, therefore we recommend limiting their utilization to brief instructions to users completing the form.

To avoid distracting the reader, there should be minimal utilization and variation of highlighted text attributes such as colour, underscore, double underscore, boldface, italics, or reverse characters (white on black or coloured background). Shadow or outline styles are too ornate for medical records.

Typestyle

Excessive variety of typestyles may distract the reader and therefore should be avoided. Type size is measured in points, each point is $^1/_{72}$ inch. As examples, Elite typing size is about 10 points, Pica is about 12 points. Odd-value point sizes (7, 9, 11 ...) should be avoided, even if they fit best, because typical commercial typsetting equipment is limited to even-value point sizes (8, 10, 12, 14 ...). A standard typestyle that is commonly used on medical forms is the sans-serif proportionally-spaced font known as Helvetica (Table I). "Sans-serif" means that the typeface lacks "tick marks" at the ends of the letter parts and therefore looks cleaner. Proportional spacing allows the space taken by each letter to vary with its width.

TABLE I Examples of Helvetica typeface

14-point plain, *oblique*, **boldface**
12-point plain, *oblique*, **boldface**
10-point plain, *oblique*, **boldface**
8-point plain, *oblique*, **boldface**

TABLE II Examples of Optima typeface

14-point plain, *oblique*, **boldface**
12-point plain, *oblique*, **boldface**
10-point plain, *oblique*, **boldface**
8-point plain, *oblique*, **boldface**

There are also commonly available compressed variants of Helvetica, such as Helvetica Condensed and the even more tightly spaced Helvetica Narrow. They are useful for fitting longer phrases into narrow spaces while maintaining readability as well as consistency with other text printed on the form.

Another sans-serif font that is popular for forms is Optima (Table II). Whereas Helvetica's stroke width is monotonically constant, Optima's stroke width varies with stroke angle and around curves, tending to be thinnest at the top and bottom and thickest at the sides. In small point sizes (8 points or less) Optima tends to "drop out" at the thinnest spots, making it less suitable for forms where small type sizes are required.

Abbreviations and short-forms

We contemplated at length the use in the anaesthesia record of abbreviations, jargon, and short forms. Their familiarity (due to frequency of use in handwritten records) and their form layout space-saving advantages were outweighed by following considerations:

1 Different places use different short forms at different times. Abbreviations and short-form terms differ

among institutions and locals. A copy of any medical record may be sent to a place where some abbreviations may be misinterpreted, ambiguous, or obscure. With the passage of time and advancing knowledge and technology, fashions in abbreviation usage can change so much that older records become difficult to understand.

2 Few abbreviations connote unique meanings across all the health care providing disciplines, even in a given locale.

3 Abbreviations should not be "grandfathered". Past usage, even if long-standing, of an abbreviation on a previous anaesthesia form should not sanction its continued use. Even frequent usage in medical literature does not make an abbreviation acceptable in a medical form. Medical journals have no system to assure unique meanings of short forms and almost any abbreviation can be published if it is defined in the text.

4 The "jargon rate" increases with discipline specialization.

5 Medical abbreviation reference books[16-18] are mere collections of short forms, useful when "decoding" abbreviations. They should not be considered to be de facto standards.

Abbreviations or short forms may be appropriate in the following circumstances:

1 SI abbreviations (le Système International d'Unités) or metric units of measurement may be used, provided they are printed using the official lettercase and notation.[19-21] Non-Greek letters should not be substituted for Greek letters, especially in SI unit abbreviations which require prefix characters such as μ for "micro-".

2 Some professional disciplines publish a list of terms, formulae, nomenclature, abbreviations, and short forms that are acceptable for use on their written examination questions.[22] Such an official document serves as an important precedent for the purposes of accepting the use of abbreviations on medical forms. Careful attention should be paid to the officially specified format including lettercase, punctuation, and special symbols or notation.

3 Where an abbreviation is so widely used that form users may be unfamiliar with the fully spelled term, both the abbreviated and the fully spelled terms should be printed. If space is limited, the fully spelled term can often be made to fit by using a condensed, narrow, or smaller variation of the typeface. Note that lowercase letters take less space than uppercase when typeset in a proportionally spaced font.

4 If other abbreviations must be used then previously published formats are preferable and their full meaning should be defined on the form.

5 The use of symbolic icons can be useful – their distinct appearance can help attract the eye to a field on the form. However, as they are subject to the same problems of interpretation between locales and over passage of time as other short forms, an explanatory word or phrase should be printed adjacent to the symbol.

Dates

We recognize the dilemma regarding variations of date format between locales. If it is acceptable to the institution, we recommend the SI format for all dates (either YYYY MM DD or YYYY.MM.DD) because it is unambiguous and is easier to sort:

- a leading zero is required on the month and day number if less than 10
- the use of a half-space as separator is preferred, but if the date is in the same line or fill-in box as other numbers then use a period as separator
- slashes or dashes should not be used as separators in SI dates, to avoid confusion with older ambiguous formats

For example, March 6, 1993 can be written as "1993 03 06" or "1993.03.06". Note that the use of an abbreviated month (e.g., 1993 Mar 06) is also unambiguous but this format can't be directly sorted because the names of the months are not in chronological sequence when sorted alphabetically.

Time of day

The 24-hour "HH:MM h" military/SI format for time of day is the least ambiguous. A leading zero should be used for the hour or minute if less than 10. The last minute in a day is defined as 23:59 h. Each day begins at midnight, which is defined as 00:00 h. Other acceptable formats include "08h05" or "0805 h".

Form name and header

Each institution should define a standard format for the form name and header, including specification of the typeface, style and size of each of the elements. We suggest that the form name be at the top left, set in a boldface 12–14 point sans-serif typeface (e.g., Helvetica), preferably in lowercase letters with Word Capitalization. The full institution name and address should be positioned below the form name, so that the loose document or copies of it are traceable to the source. The department name, if shown, should be below the institution name and address. Finally a unique form identifier, version number, and artwork revision date should be shown.

The version number and revision date should be updated every time the artwork is altered, no matter how trivial the change. The purpose of the revision date is to document definitively which version of the artwork is the most recent revision, and to allow a set of revisions to be sorted in chronological order.

We recommend the following format for the artwork revision number: major.minor(edit#). The number to the left of the decimal is incremented with each major artwork revision. The number to the right of the decimal is incremented with each minor revision and is zeroed with each major revision. If a change is trivial we append a single letter or "sub-version" to the minor version number. The edit number, in parentheses, is incremented every time the artwork is edited or changed.

Area reserved for patient identification card imprint
A specific area, typically the top right corner, of medical forms is normally reserved for the imprint of the patient identification (ID) card. Each institution should have written guidelines for defining the minimum and maximum dimensions of this area. The required clearance from the edges of the paper should be included in these dimensions.

If a card imprinter is used we recommend allowing larger than the minimum space for this area, especially the width, because people have difficulty perfectly aligning the card with the form. We have found that a thick solid black border (3–4 points) around the area also helps users imprint the card "on target".

Double-sided or multi-page forms should preferably have an area used for the patient ID imprint on each page, because any page may be viewed, transmitted or copied apart from the rest of the health record.

Lines and boxes
Lines and boxes can be used to group items and to guide the eye's reading path, but their excess use clutters the form. Hairlines ($^1/_4$-point) interfere the least with legibility. A one- to two-point line may be used to separate distinct sections.

Checkboxes
Checkboxes should be standardized. We recommend a square shape (distinct from small rectangular fill-in boxes), of hairline thickness, without rounded corners or shadows. The extra ink of thicker lines or shadows interferes with recognition of written or typed marks made in the checkboxes.

Each checkbox should be equal in height to the tallest letter of the font used in the adjacent text. The bottom edge of each checkbox should be aligned with the baseline of the adjacent text.

All checkboxes on the Anaesthesia Record should be positioned to the left of the applicable text items to help the eye rapidly scan for those items that have been selected. At least a single space gap should be inserted between each checkbox and the adjacent text item (alternatively $^1/_3$ to $^1/_2$ of the width of the checkbox works well, but the gap width should be consistent throughout the form). Other text items on the same line should be separated by at least a 3-space or 2-checkbox-width gap.

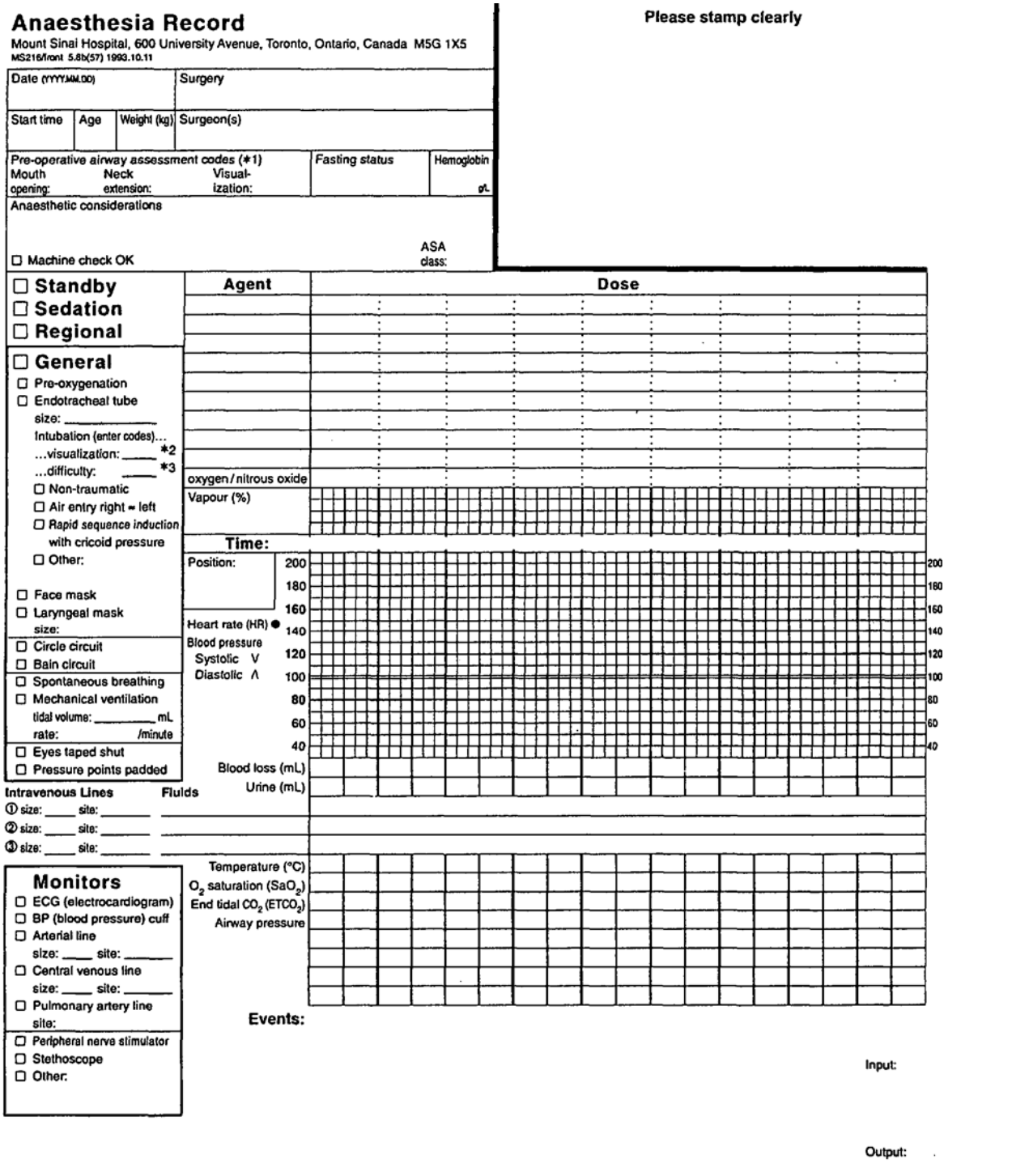
Grids
Grids are used to graph variables that are being monitored (e.g., blood pressure, heart rate, temperature). Hairlines should be used for most of the lines on these grids, to maximize visibility of handwritten data. Slightly thicker guide lines can be inserted at regular intervals to aid in following and counting lines. The symbols that will be used to plot the data points should be defined in an area adjacent to the grid.

Test results
Copying of laboratory, radiological, or other diagnostic testing results risks transcription errors, is unavoidably incomplete, and has no official status. However, copying test results to the front of the anaesthesia record gives the anaesthetist immediate access to critical test results and retrospectively proves that they were noted at the time of the procedure.

Reduction to practice
The preceding discussion is extensive and minutely detailed. However, the application of the guidelines presented results in a neat, uncluttered, and efficient anaesthesia chart (see Figure). The form is letter-size, in portrait orientation (all text is upright, reading from left to right), has a $^3/_4$-inch left margin for five-hole punching, and has an appropriately sized and demarcated area for the patient identification imprint, all in compliance with our hospital's health records guidelines. The border around the patient identification area is three points thick to help users "hit the target" when using the ID card imprinter.

The basic graphing grid is an array of vertical 0.1 point hairlines at five-minute intervals and horizontal hairlines at ten-unit intervals. There are thickened vertical lines of 0.5 points at 15-minute and one point at 30-minute intervals. The horizontal lines are thickened to 0.5 points at 40-unit intervals and there is a double hairline at 100 units. This grid configuration helps the user graph data without the tedium of repeated reference to the numeric scales. The numeric scale is repeated on the right side of the grid for convenience. The boxes around the "General" and the "Monitors" sections are one point thick to clearly group together the items in these sections. All other lines on the form are 0.1 point hairlines to minimally interfere with handwriting visibility.

All text was typeset in the Helvetica font (plain, bold, or narrow) and the Zapf Dingbats font was used for checkboxes, icons, and special symbols.[23] For maximum



Anaesthesia Record

Mount Sinai Hospital, 600 University Avenue, Toronto, Ontario, Canada M5G 1X5

MS216/front 5.8b(57) 1993.10.11

Please stamp clearly

Date (YYYY.MM.DD) | Surgery

Start time | Age | Weight (kg) | Surgeon(s)

Pre-operative airway assessment codes (*1): Mouth opening: | Neck extension: | Visual-ization: | Fasting status | Hemoglobin g/L

Anaesthetic considerations

☐ Machine check OK

ASA class:

☐ Standby
☐ Sedation
☐ Regional

☐ General
- ☐ Pre-oxygenation
- ☐ Endotracheal tube
  - size: _____
  - Intubation (enter codes)...
  - ...visualization: ____ *2
  - ...difficulty: ____ *3
  - ☐ Non-traumatic
  - ☐ Air entry right = left
  - ☐ Rapid sequence induction with cricoid pressure
  - ☐ Other:
- ☐ Face mask
- ☐ Laryngeal mask size:
- ☐ Circle circuit
- ☐ Bain circuit
- ☐ Spontaneous breathing
- ☐ Mechanical ventilation
  - tidal volume: _____ mL
  - rate: /minute
- ☐ Eyes taped shut
- ☐ Pressure points padded

Agent | Dose

oxygen / nitrous oxide

Vapour (%)

Time:

Position:

Heart rate (HR) ●

Blood pressure
Systolic V
Diastolic Λ

200 180 160 140 120 100 80 60 40

Blood loss (mL)

Urine (mL)

Intravenous Lines — Fluids

① size: ____ site: _____

② size: ____ site: _____

③ size: ____ site: _____

Monitors
- ☐ ECG (electrocardiogram)
- ☐ BP (blood pressure) cuff
- ☐ Arterial line size: ____ site: _____
- ☐ Central venous line size: ____ site: _____
- ☐ Pulmonary artery line site:
- ☐ Peripheral nerve stimulator
- ☐ Stethoscope
- ☐ Other:

Temperature (°C)

O_2 saturation (SaO_2)

End tidal CO_2 ($ETCO_2$)

Airway pressure

Events:

Input:

Output:

End time: Neuromuscular block reversal:

Post-Anaesthetic Care Unit HR: BP: RR: SaO_2: FIO_2:

*1, *2, *3 — see code definitions and pre-operative patient assessment overleaf...

Anaesthetist / Assistant: MD

Abbreviations: ASA=American Society of Anesthesiologists, FIO_2=Fraction of Inspired Oxygen, RR=Respiratory Rate

FIGURE

readability, all of the words are spelled out in lowercase characters. To differentiate phrases from titles, the phrases start with a capital letter whereas titles are Word Capitalized. Abbreviations conform to SI format or follow customary usage. All non-Si abbreviations are defined on the form, either at the first place where they appear or in alphabetical order in the footnote at the bottom of the page. Entry fields that are not individually delimited by lines have a colon after the field prompt to indicate the position for the entry.

The form header including title, full institution name and address, form number, version number, and artwork revision date are shown at the top left. Information entry begins with the procedure date and start time, type of operation, name of surgeon(s), age, weight, haemoglobin, pre-operative airway assessment, and other anaesthetic considerations. We developed our own three-category pre-operative airway assessment, each with three classes, reduced to a series of single-character codes. This established a consistent format for quickly recording and communicating the airway assessment, and simplified database collection. We defined the cost meanings (Table III) on the back of the form, where there is more space, along with additional codes for subsequent visualization and difficulty at intubation (Tables IV and V).

A series of items oriented vertically along the left side of the chart identifies the type of anaesthetic, ordered from least invasive (standby) to most invasive (general). Checkbox items for documenting the management of the airway, within the "General" section, are arranged in order of frequency of usage. Below this are choices of anaesthetic circuit type and ventilation mode, with horizontal hairlines delineating these subsections.

At the top of the data entry section, a blank table is provided for the entry of the names of the agents used. The dose is recorded to the right, at a space corresponding to the time that the agent was administered. The only agent name that is pre-printed is the frequently used combination, oxygen/nitrous oxide. The end tidal concentrations of inhalational agents, analogous to the dose of intravenous agents, are graphed in the high density grid below the table. The user must write in the appropriate numeric scale.

The box labelled "Position", adjacent to the top left of the graphing grid, is for drawing a "cartoon" representing the patient's posture on the table.

The "Monitors" section lists monitors employed during the procedure. Variables that are repeatedly measured, such as temperature, oxygen saturation, end tidal carbon dioxide tension, and airway pressure, are placed next to the data grid where readings are to be recorded. Because the presence of data recorded in the grid implies use of the corresponding monitor, we omitted temperature probe, pulse oximeter, capnograph, and airway pressure gauge from the "Monitors" section. Monitors are grouped into cardiovascular, respiratory and "other" categories. The cardiovascular monitors are ordered from more commonly used and least invasive to less common and most invasive.

Heart rate and blood pressure are plotted in the graphing grid. Below this, measurements which have a low sampling frequency (e.g., blood loss, urine output, intravenous fluid infusion, temperature, oxygen saturation, end tidal carbon dioxide tension, and airway pressure) are recorded in the data grid. Blank lines are allocated within the data grid for recording any additional variables.

Ample blank space is provided near the bottom of the form to use for recording noteworthy complications or events that occur during the procedure, as well as a summary of the fluid input and output. At the bottom of the form is a line to document the procedure end time and neuromuscular block reversal, followed by fields to record the patient's status in the Post-Anaesthetic Care Unit, and finally the signature of the anaesthetist/assistant.

TABLE III Pre-operative airway assessment codes(*1)

Mouth opening
(a) ≥3 fingers
(b) ≥2 fingers
(c) ≥2 fingers
Neck extension
(a) normal movement of atlanto-axial and vertebral joints
(b) moderate limitation at atlanto-axial or vertebral joints
(c) marked limitation at atlanto-axial or vertebral joints
Visualization pre-operatively
(a) normal visualization of pharynx and pillars
(b) all of soft palate seen
(c) less than all of soft palate seen

TABLE IV Codes for visualization at intubation (*2)

1 All of larynx and vocal cords
2 Arytenoids and part of larynx and cords
3 Epiglottis and arytenoids only
4 Epiglottis only (or nothing)

TABLE V Intubation difficulty codes (*3)

1 First attempt, easy
2 Some manipulation of larynx, laryngoscope or endotracheal tube required
3 Passed endotracheal tube "blind" or failed first attempt
4 More than two attempts or failed intubation

Conclusion

The documentation of modern anaesthetic practice requires a more complex chart than the basic grid for graphing blood pressure and heart rate as suggested by Cushing and Codman in 1894. The chart's utility as a health record can be improved by deliberate and carefully considered decisions regarding which additional information to document, entry format, page layout, and typesetting specifications. We examined all of these aspects to improve the chart's logical arrangement and efficiency of use.

Fulfilling the many requirements was greatly facilitated by using a desktop publishing system which provided extensive flexibility, short turnaround time between revisions, and direct high-resolution electronic transfer to photographic paper or film. This system will continue to assist with implementation of future revisions that will inevitably be necessary.

We presented our form design rationale in the belief that it ought to be applicable wherever a similar approach to anaesthesia is practiced.

References

1 *Sechzer PH.* Anesthesia documentation and evaluation. QRB Qual Rev Bul 1981; 7: 28–34.

2 *Lundy JS.* Keeping anesthetic records: and what they show. Am J Surg 1924; 38: 16–25.

3 *Beecher HK.* The first anesthesia records (Codman, Cushing). Surg Gynecol Obstet 1940; 71: 689–93.

4 *Dripps RD, Eckenhoff JE, Vandam LD (Eds.)* Introduction to Anaesthesia – The Principles of Safe Practice, 6th ed. Philadelphia: W.B. Saunders Company, 1982: 90.

5 *Wright AJ.* Early use of the Cushing-Codman anaesthesia record [Letter]. Anesthesiology 1987; 66: 92.

6 *Maltby JR, Shephard DAE (Eds.).* Harold Griffith: his life and legacy. Can J Anaesth 1992; 39: Supplement: 29.

7 *Seed RF, Welsh EA.* Anaesthesia records in Great Britain and Ireland. Anaesthesia 1976; 31: 1199–210.

8 *Bembridge M, Bembridge JL.* A survey of anaesthetic charts. Anaesthesia 1988; 43: 690–3.

9 Public Hospitals Act, Revised Statutes of Ontario, 1990, c. P.40 and regulations thereunder, Hospital Management Regulations, Revised Regulations of Ontario 1990, regulation 965, section 27(5), formerly Ontario Regulation 518/88.

10 Guidelines to the Practice of Anaesthesia as recommended by the Canadian Anaesthetists' Society, revised 1993. Can J Anaesth 1993; 40 Supplement: 9.

11 The College of Physicians and Surgeons of Ontario (CPSO) and The Ontario Medical Association (OMA). Report of the Anaesthesia Liaison Committee of CPSO and OMA for The Practice of Anaesthesia in Ontario (Draft). 1989: 13.

12 *Epstein BS.* Documentation of anesthesia care. In: Peer Review in Anesthesiology. Park Ridge, Illinois: The American Society of Anesthesiologists, 1991; 26.

13 *Anonymous.* ASA standards for basic intra-operative monitoring. In: Peer Review in Anesthesiology. Park Ridge, Illinois: The American Society of Anesthesiologists, 1991: 41–2.

14 *Kleper ML.* The Illustrated Handbook of Desktop Publishing and Typesetting, 2nd ed. Blue Ridge Summit, PA: Tab Books, 1990: 16–31.

15 *Porozny GHJ.* Desktop Publishing Basics and Applications. Toronto: Copp Clark Pitman Ltd., 1993.

16 Stedman's Abbreviations, Acronyms & Symbols. Baltimore: Williams and Wilkins, 1992.

17 *Steen EB.* Baillière's Abbreviations in Medicine, 5th ed. Toronto: Baillière Tindall, 1984.

18 CPS Abbreviations, Medical and Pharmaceutical. *In:* Compendium of Pharmaceuticals and Specialties. Ottawa: Canadian Pharmaceutical Association.

19 Sub-Committee of Metric Commission Canada Sector 9.10 Health and Welfare. The SI Manual in Health Care, 2nd ed. Toronto: Ontario Government Bookstore, 1982.

20 Metric Commission Canada. How to Write SI, 6th ed. Ottawa: Minister of Supply and Services, Canada, 1982.

21 *McQueen MJ.* SI Units. A Practical Guide for Health Professionals. Burlington, Ontario: Simole Consultants Ltd., 1982.

22 Examination Advisory Comittee. Standardized terms, symbols and physiological calculations nomenclature and normal values. *In*: Examination Information Manual, Canadian Board of Respiratory Care Inc., 5th ed. 1994

23 Adobe POSTSCRIPT® language Type 1 outline font software, Adobe Systems Incorporated, 1585 Charleston Road, POB 7900, Mountain View, California, USA 94039-7900.