

How to Write a Scientific Paper for Publication

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Learning objectives:

1. Participants will gain techniques to overcome writer's block.
2. Participants will learn to use the structure of scientific papers to make writing easier.
3. Participants will understand how to use guidelines for common types of papers in laboratory medicine.

Bonus: Participants may learn something from humorous examples of the errors we all make.

Dear Sir or Madman

Please send us the forms for
your vapid communications.

Submission Cover Letter:

I have received no sources of support [sic] for this work. In fact, the article was written on a Sunday afternoon, and my wife was not very supportive of this effort.

To *Clinical Chemistry*:

The authors warrant that the work is original and, if accepted, will not be published elsewhere without the written permission of *Blood Coagulation and Fibrinolysis*.

Manuscript

Introduction

We evaluated an ultrasensible CRP assay...

Associate Editor's Comment:

For use by level-headed physicians.

Manuscript (Methods Section)

Serum samples were collected from
patients enrolled in a clinical trial
and stored in a -20°C
freezer.

Transfer the
supernatant to a
conical tube.

Manuscript

Results Section

...72% of the patients had
chronic lactic
acidemia ...

Reviewers' Comments

There are many
misspelled words and
typographical
mistakes.

[Anonymous reviewer]:
My name is misspelled in Ref
14.

Authors' response to reviewers' comments

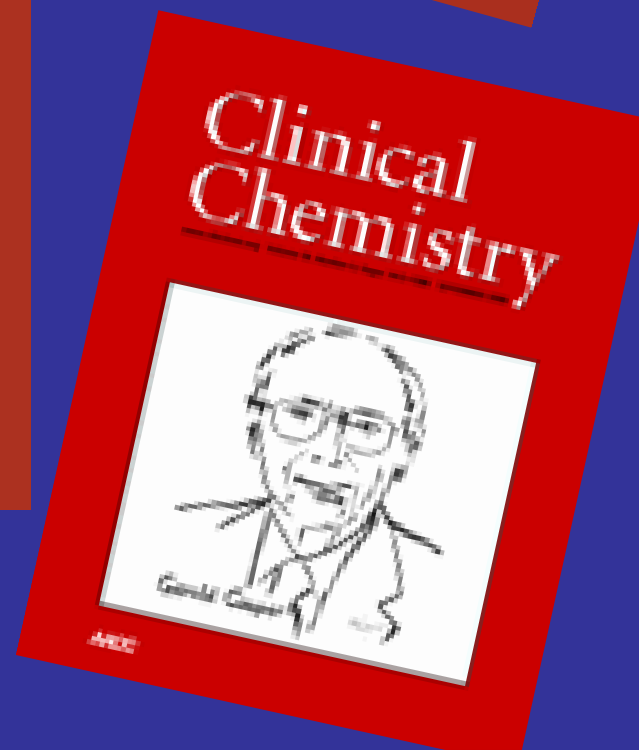
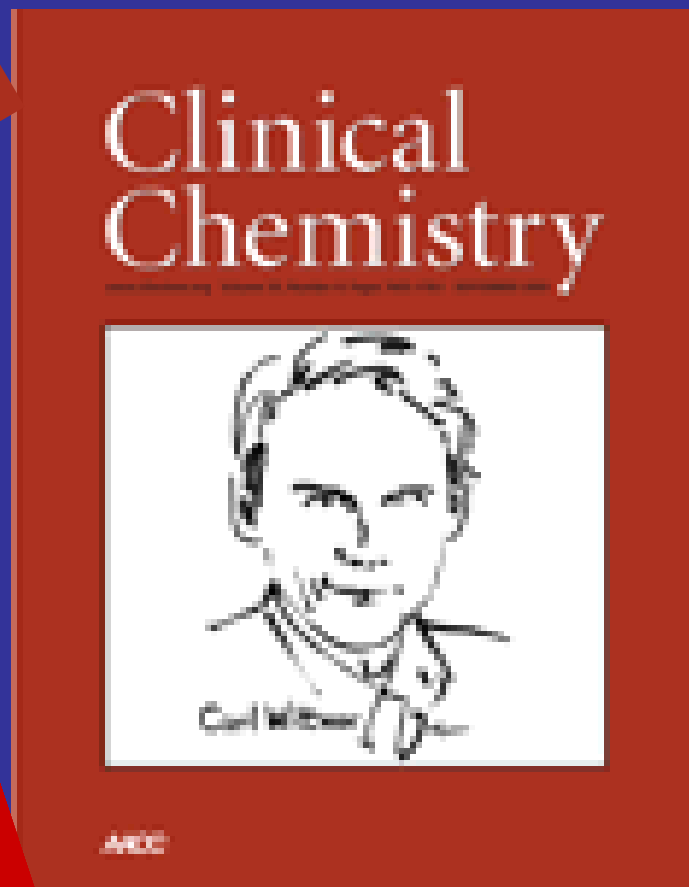
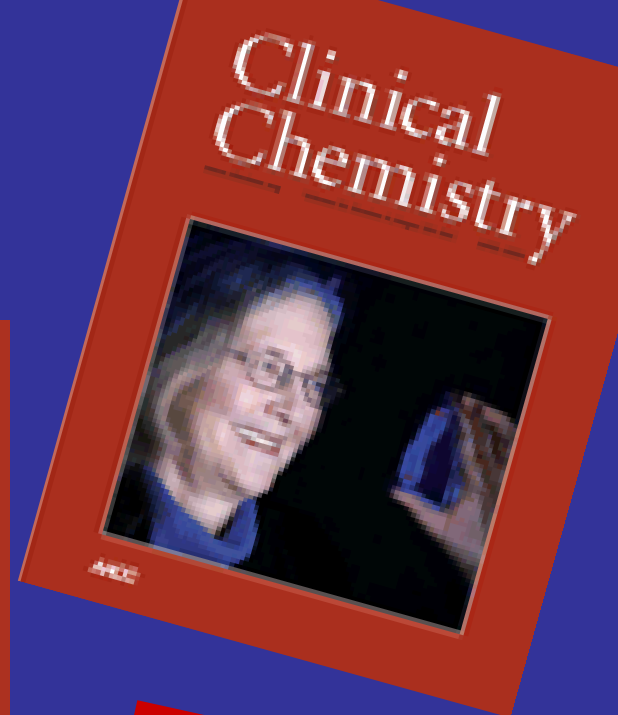
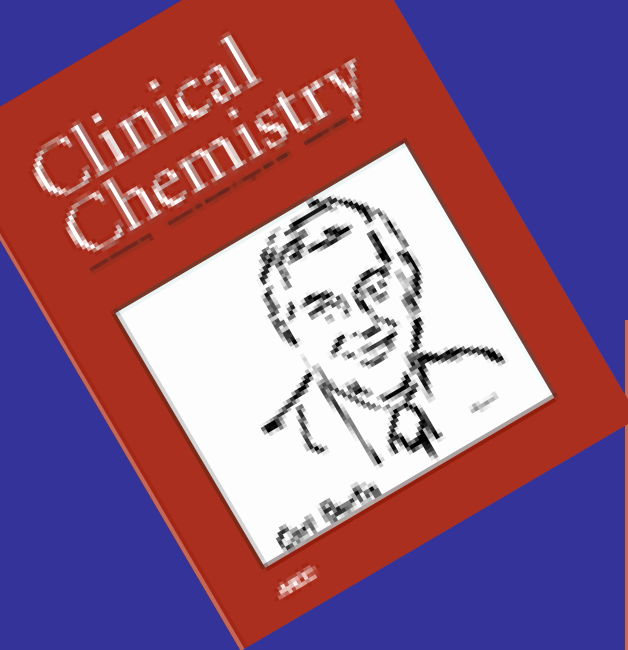
Reviewer 1 has given
us
fool for thought.

We are unable to comply with the request for statistical analysis of the values in Table in Table 1 as the experiment cannot be duplicated.

The design of our study does not
allow to confirm or infirm this
finding.

I have examined the revision of
manuscript 15-XXX and find
that the changes are exclusively
changes in the distance
between the left and right
margins.

How To Write a Paper



Everyone can become an
acceptable, even good,
writer.

But only if we write.

Initial Steps in Preparation

- Inspiration
 - Driving
 - Shower
 - 3 AM
- Write down ideas as they come
- The first draft is only that.
- Plan to write at least 5 drafts



Basic Requirements for a Good Article

- Something to say

- New

- True

$$F = 4\pi^2 m R / T$$

- Important

Objectively -- $r = 0.99$

Subjectively -- for author

Criteria for Medical Communications

- New: reaffirmation, refutation, synthesis, elaboration, compilation
- True
- Important
- Comprehensible

So, you have done some work and
have something to say.

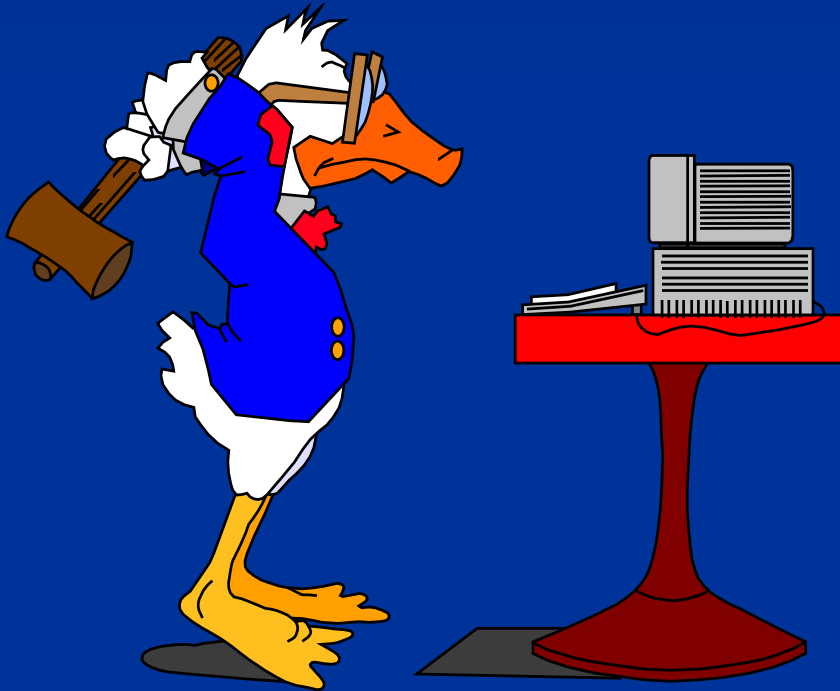
Now what?

Initial Steps in Preparation

- Literature review (don't get bogged down)
- *Outline* (work in progress)
- Consult a statistician (better at beginning of study)

But then the impediments to actually
writing raise their ugly heads...

Do My Work ... and Write, Too?



- Many demands
- Little preparation
- Competing responsibilities

Impediments to Writing

- Lack of time
- Words don't come
- Don't like writing
- Interruptions
- Poor organizer
- Difficulty completing tasks
- Can't use Word
- Can't concentrate
- No quiet place
- Difficulty starting
- Overwhelming task
- Fear of criticism

We are all apprentices of a craft
where no one ever becomes a
master.

--E. Hemingway

Impediments to Writing

- Lack of time
- Words don't come
- Don't like writing
- Interruptions
- Poor organizer
- Difficulty completing tasks
- Hate dictating
- Can't use Word
- Can't concentrate
- No quiet place
- **Difficulty starting**
- **Overwhelming task**
- Fear of criticism

Getting Started on an “Overwhelming” Task

Use the structure of scientific papers to
start a first draft for a **section** of the
manuscript.

Structure of Scientific Papers:

IMRAD

- Title
- Abstract
- Introduction
- Methods
- Results and
- Discussion
- References
- Figures and Tables

Structure of Scientific Papers:

IMRAD

- Title
 - Abstract
 - Introduction
 - Methods
 - Results and
 - Discussion
 - References
 - Figures and Tables
- The sequence of writing need not follow the printed sequence.
 - The abstract is often the last thing written, not the first.

Getting Started: Break the Writing into Bite-Sized Pieces

- Introduction
- Methods
- Results and
- Discussion

Getting Started: Break the Writing into Bite-Sized Pieces

- Introduction
 - Methods
 - Results and
 - Discussion
- Start with the part of the work with which you are most familiar.
 - If you generated the data, start with your Methods or Results.
 - If you are working at the “30,000-foot level”, start with concepts (in Introduction), ease into the “meat”.

Structure vs Sequence of Writing

STRUCTURE

1. Abstract
2. Introduction
3. Methods
4. Results and
5. Discussion

Liz Bruns's SEQUENCE

1. Figures/Tables
2. Results
3. Methods
4. Discussion
5. Introduction
6. Abstract

Structure vs Sequence of Writing

STRUCTURE

1. Title
2. Abstract
3. Introduction
4. Methods
5. Results and
6. Discussion

Liz Bruns's SEQUENCE

1. **Figures/Tables** (plans on several hours over a few days to organize data and make images)
2. **Results** (2 days)
3. **Methods** (1-2 days)
4. **Discussion** (2 days)
5. **Introduction** (1 day)
6. **Abstract**

Structure vs Sequence of Writing

STRUCTURE

1. Title
2. **Abstract**
3. Introduction
4. Methods
5. Results and
6. Discussion

Alternative SEQUENCE

1. Working Title (to focus the mind)
2. Outline of key points for each section
3. Introduction-Figures-Tables-Results-Methods-Discussion-Title
4. **Abstract**

Tip

- If you have read a paper (or grant application) that you think is clear and easy to understand, it probably is.
- It is ok to use that paper (or grant application) as a model for your paper (or grant application)
- But you can't use the data!

Title

- Start with a working title.
- Can change it later.
- Most-frequently-read part of any article
- Must catch reader's attention
 - Short and informative
 - Need not be “cute” or humorous

Abstract

If you like, write a first draft:

It's only a draft!

Abstract

If you like, write a first draft:

It's only a draft!

“When you are out to describe the truth, leave elegance to the tailor.”

--Albert Einstein

Abstract

- Background plus hypothesis, aim or question to be addressed
- Methods – Some detail
- Results – Usually numeric (CI)
- Conclusion(s) - Must be supported results

Introduction

- Hook reader
 - 1st sentence and paragraph
 - Often: Why the field is important
- Background information
 - Tell what's been done
- Why the proposed work (study, review) is needed
 - Tell what's missing.
- Clear formulation of question or hypothesis or aim
 - This really gives a clue to how the work will fill in the missing information

Introduction - Common Faults

- Too long
- Inclusion of tangential material
- Failure to mention relevant studies
- Inclusion of methods
- **Inclusion of results**
- Inclusion of discussion material

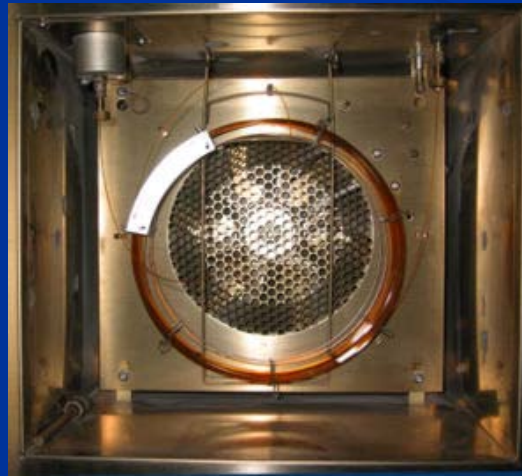
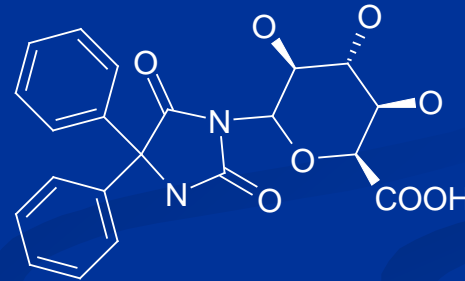
Methods Section

Methods:

**Transfer the
supernatant to a
comical tube.**

Materials and Methods

- How and what of paper
- Sufficient information to allow evaluation and replication
- Remember to describe **statistics.**



Statistics

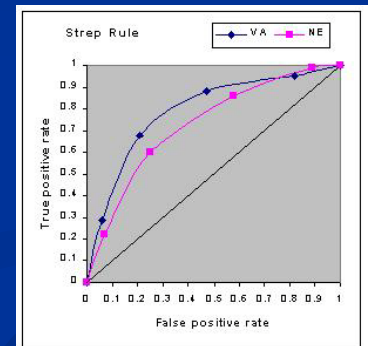
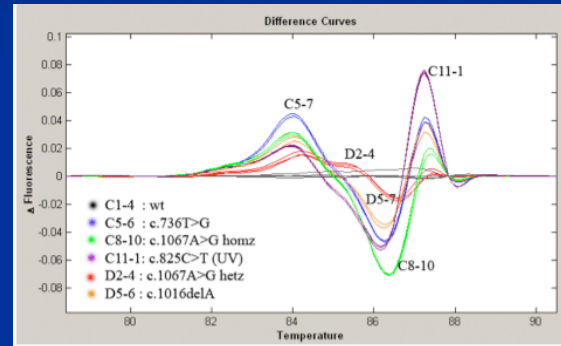
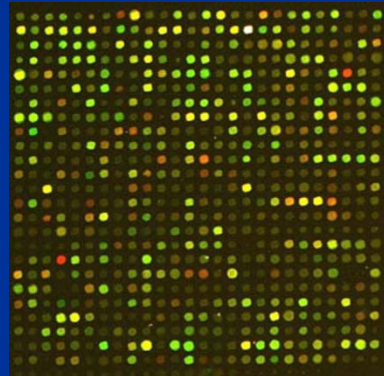
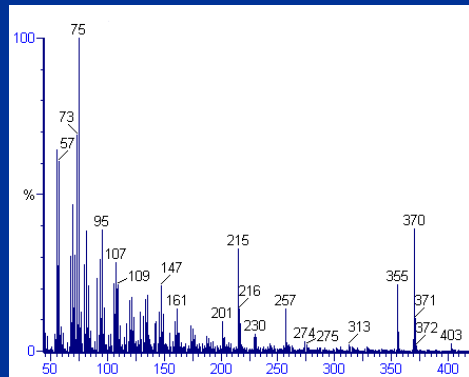
- Reviewer: The authors should use a paired t-test.

Statistics

- Reviewer: The authors should use a paired t-test.
- Author's response: We used paired and **impaired** t-test.

Results

- A way to start this section is to make a set figures and tables and arrange them to tell a story.



- Then write text to go with them.
- The required content of the Results section depends on type of study: Analytical, clinical, etc.

Common Types of Studies in Laboratory Medicine

1. Analytical: Accuracy, precision...
2. Nonmetrological Factors: Biologic variation...
3. Diagnostic Accuracy: LR, ROC...
4. Clinical Usefulness: Outcomes...
5. Cost-benefit Analysis: Cost/QALY...

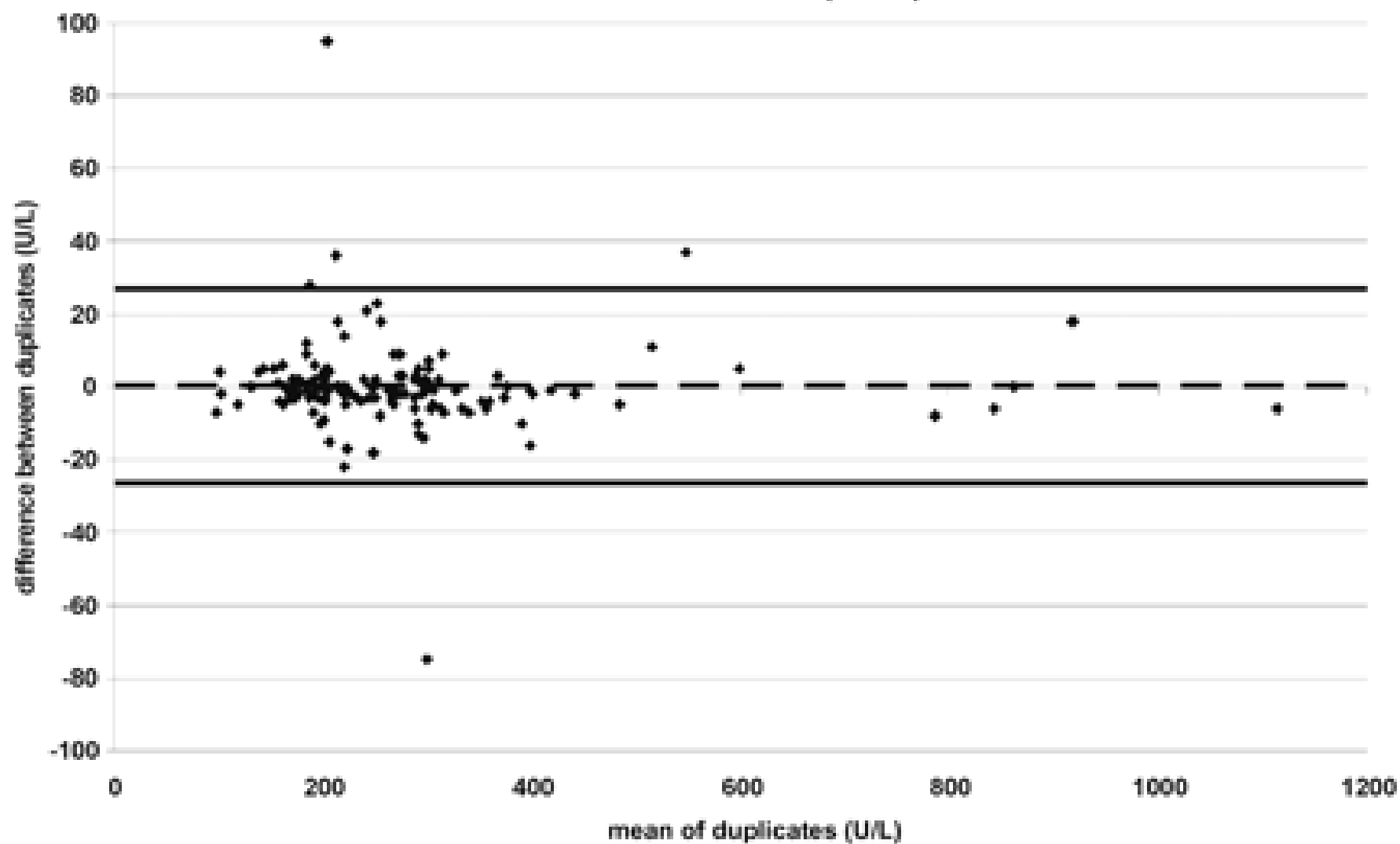
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Analytical Studies

- Linearity
- Imprecision studies – Describe
- Limit of Detection or Limit of the Blank– Define
- Limit of quantification, recovery of added analyte, interferences, reference interval
- Method comparison - Not $p < 0.05$
 - SD of residuals
 - Deming regression
 - Difference plot (Bland-Altman)

LD measurements (IFCC)



Analytical Studies

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Characterizations of Medical Tests

1. Analytical: Accuracy, precision...
2. Nonmetrological Factors: Biologic variation...
3. **Diagnostic Accuracy: LR, ROC...**
4. Clinical Usefulness: Outcomes...
5. Cost-benefit Analysis: Cost/QALY...

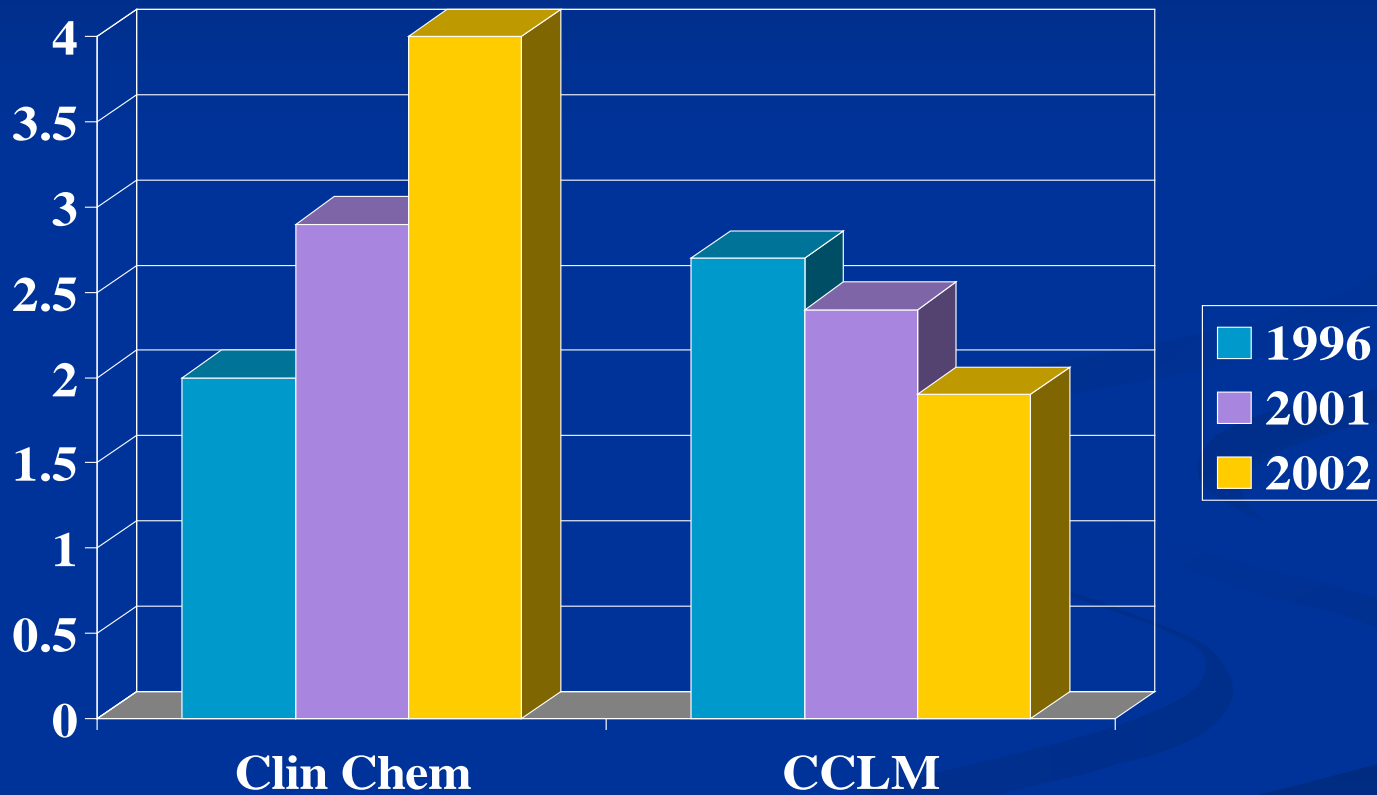
Studies of Diagnostic Accuracy

- Use STARD checklist as guide to items to include:
 - Spectrum of disease - Sx
 - Results for subgroups - eg, +/- Sx
 - Test reproducibility - eg, CV
 - etc

Section and Topic	Item	Describe	On page
TITLE/ABSTRACT/KEYWORDS	1	Identify the article as a study of diagnostic accuracy (recommend MeSH heading 'sensitivity and specificity').	
INTRODUCTION	2	State the research questions or study aims such as estimating diagnostic accuracy or comparing accuracy between tests or across participant groups.	
METHODS		Describe	
<i>Participants</i>	3	The study population: The inclusion and exclusion criteria, setting and locations where the data were collected.	
	4	Participant recruitment: Was recruitment based on presenting symptoms, results from previous tests, or the fact that the participants had received the index tests or the reference standard?	
	5	Participant sampling: Was the study population a consecutive series of participants defined by the selection criteria in 3 and 4? If not, specify how participants were further selected.	
	6	Data collection: Was the data collection planned before the index tests and reference standard were performed (prospective study) or after (retrospective study)?	
<i>Test methods</i>	7	The reference standard and its rationale.	
	8	Technical specifications of material and methods involved including how and when measurements were taken, and/or cite references for index tests and reference standard.	
	9	Definition of and rationale for the units, cutoffs and/or categories of the results of the index tests and the reference standard.	
	10	The number, training and expertise of the persons executing and reading the index tests and the reference standard.	
	11	Whether or not the readers of the index tests and reference standard were blind (masked) to the results of the other test and describe any other clinical information available to the readers.	
<i>Statistical methods</i>	12	Methods for calculating or comparing measures of diagnostic accuracy, and the statistical methods used to quantify uncertainty (e.g. 95% confidence intervals).	
	13	Methods for calculating test reproducibility, if done.	
RESULTS		Report	
<i>Participants</i>	14	When study was done, including beginning and ending dates of recruitment.	
	15	Clinical and demographic characteristics of the study population (e.g. age, sex, spectrum of presenting symptoms, comorbidity, current treatments, recruitment centers).	
	16	The number of participants satisfying the criteria for inclusion that did or did not undergo the index tests and/or the reference standard; describe why participants failed to receive either test (a flow diagram is strongly recommended).	
<i>Test results</i>	17	Time interval from the index tests to the reference standard, and any treatment administered between.	
	18	Distribution of severity of disease (define criteria) in those with the target condition; other diagnoses in participants without the target condition.	
	19	A cross tabulation of the results of the index tests (including indeterminate and missing results) by the results of the reference standard; for continuous results, the distribution of the test results by the results of the reference standard.	
	20	Any adverse events from performing the index tests or the reference standard.	
	21	Estimates of diagnostic accuracy and measures of statistical uncertainty (e.g. 95% confidence intervals).	
<i>Estimates</i>	22	How indeterminate results, missing responses and outliers of the index tests were handled.	
	23	Estimates of variability of diagnostic accuracy between subgroups of participants, readers or centers, if done.	
	24	Estimates of test reproducibility, if done.	
DISCUSSION	25	Discuss the clinical applicability of the study findings.	

Mean Number of Criteria Met

(Lumbreras-Lacarra et al, 2004)



(*Clin Chem*, $p < 0.001$; *CCLM*, $p = 0.7$)

Studies of Diagnostic Accuracy

- Use STARD checklist Spectrum of disease - Sx
- Use flow diagram to keep track of patients

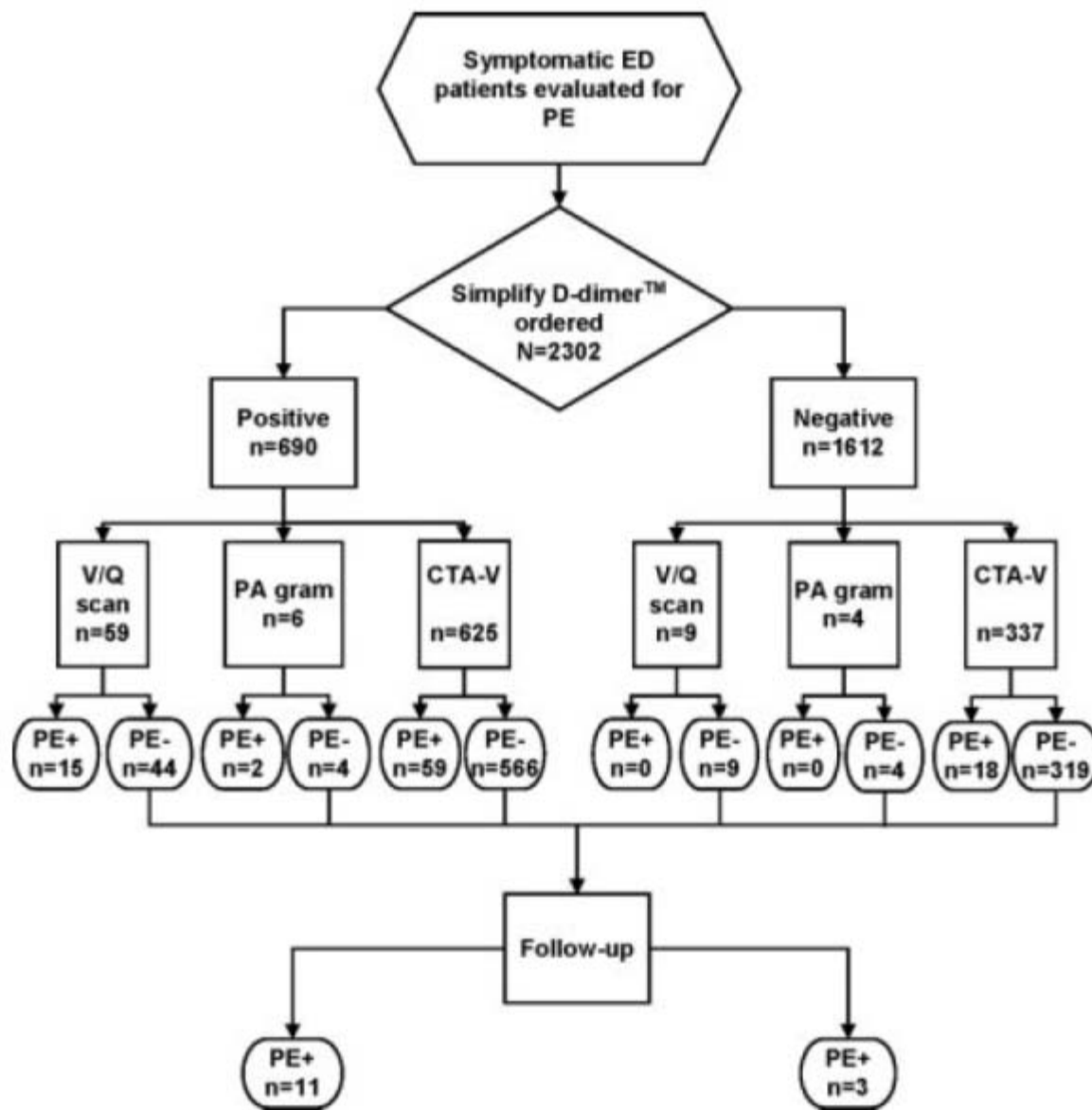


FIGURE 1. Flow diagram of diagnostic imaging performed in all patients. V/Q = ventilation/perfusion; PA gram = pulmonary angiogram; CTA-V = CT angiography-venography.

Characterizations of Medical Tests

1. Analytical: Accuracy, precision...
2. Nonmetrological Factors: Biologic variation...
3. Diagnostic Accuracy: LR, ROC...
4. **Clinical Usefulness: Outcomes...**
5. Cost-benefit Analysis: Cost/QALY...

Outcomes Studies

- Effect of test X on patient's outcome Y
 - Fecal occult blood testing decreases colon cancer deaths
- Ideal design is randomized controlled trial (RCT)
- Use checklist of Consolidated Standards of Reporting Trials (CONSORT) as guide for writing paper:
 - Strict inclusion/exclusion criteria
 - Patient flow (dropouts, etc)
 - Provide confidence intervals, etc.

Results -

Tips To Improve Odds of Success

- Tables and figures comprehensible on their own
- Figures of good quality.
- Little or no repetition of data in text, tables, figures
- Appropriate statistical analyses
- Reasonable numbers of significant figures:

Glucose = 105 mg/dL, not 105.226 mg/dL

Discussion

Lead reader logically through results:

1. summarize and interpret findings
2. compare with previous work
3. discuss implications
4. speculation
5. limitations
6. next steps

Discussion - Simple Faults To Avoid

- Repetition of introduction
- Excessive repetition of results
- Discussion not based on aim of study or results
- Presentation of new data
- Failure to discuss results
- Conclusions not based on results

References

- 25% of references in papers have been in error
- 8% of references in Clin Chem cannot be linked to PubMed
- Check the article itself to be sure; avoid secondary sources
- Use *Reference Manager*, *EndNotes* or similar
- Many journals (e.g., Clin Chem) create links of references to PubMed at time of on-line ms submission: If reference does not link, look for errors and resubmit paper on on-line.

Refine the Structured Abstract (≤ 250 words)

- **Background** (including aim of study): Two sentences
- **Methods**: Sufficient to allow an understanding of source of results
- **Results**: Data (numbers, statistics) to support conclusion
- **Conclusion(s)**: One or two sentences

Refine Title

- Capture article's final content
- Include words that will increase likelihood of retrieval in searches at Google (ranks #1) and PubMed.
- Concise:
 - Report on the measurement of glucose by use of mass spectrometry
 - Mass spectrometric glucose assay

Where To Publish



- Selecting a journal
 - Have journal or specific audience in mind before writing
 - Look at copy of the journal
 - Consider impact factors (ISI)

Impact Factor

- Premise:

A paper that is never cited probably had little impact on its field.

- Impact factor of a journal:

A measure of the average frequency of citations of articles published in the journal.

- The 2008 impact factor =

(The number of citations by all journals during 2008 of articles published in journal X during 2006 and 2007)
divided by (the number of articles published in journal X in 2006 and 2007).

Interpretation and use of impact factors

- Impact factors agree with specialists' ranking of journals in their areas.
- Cannot compare journals in different disciplines.
- Impact factors influence promotion committees and funding agencies.
- Generally want to pick a journal with good impact factor for its field.

Authorship



- Ethical considerations
 - honesty
 - credit

Authorship

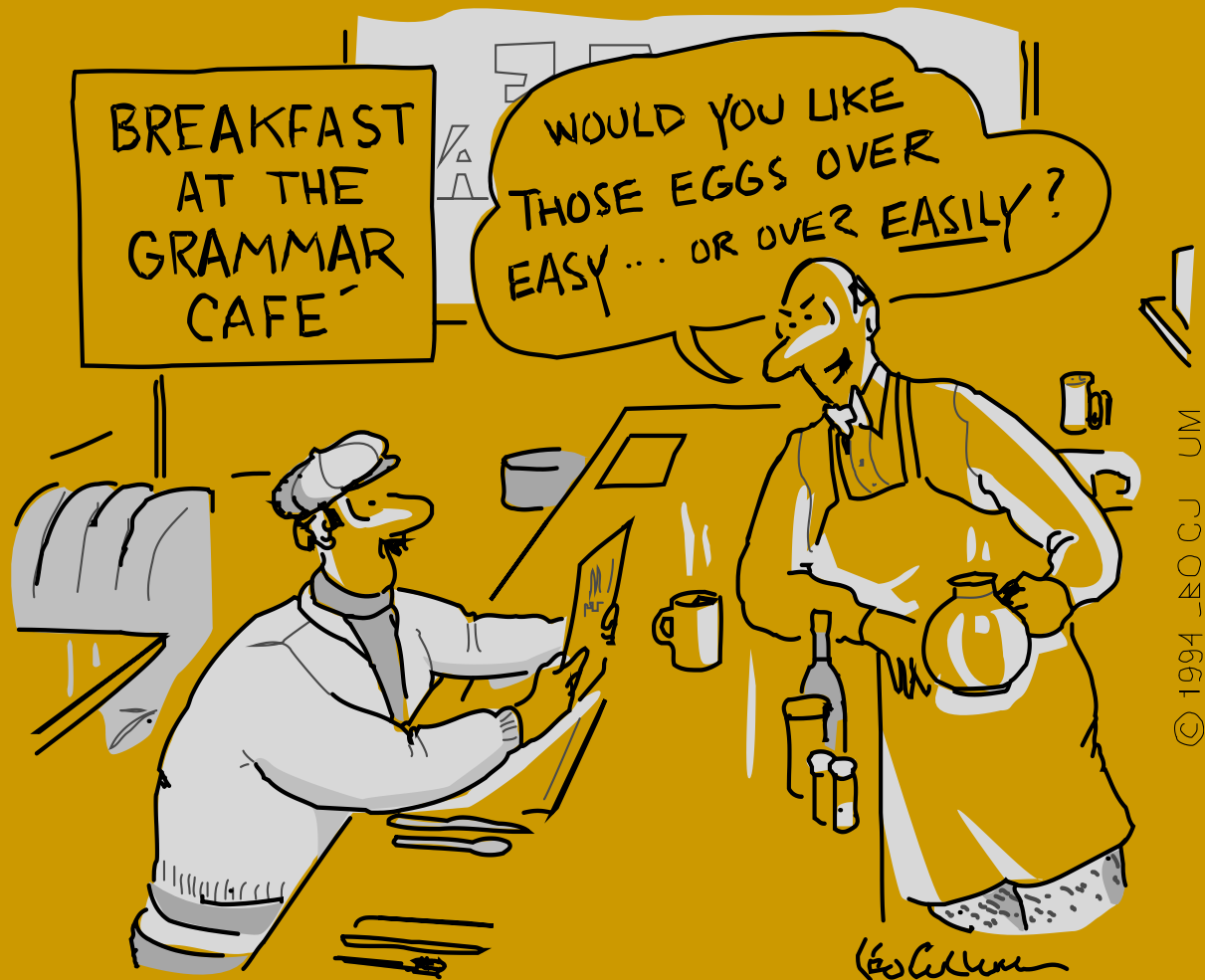
- Whom to include
- Decide up front
 - Who?
 - What order?
- Only those with significant contributions

International Committee of Medical Journal Editors

- Qualification for authorship
 - Contribute to
 - conception, design, analysis, or interpretation,
 - drafting and revising manuscript, and
 - approval of final version
- Order of authorship is joint decision of authors, not editor.

Writing

Grammar Problems



Basic Requirements for a Good Article

- Simplicity
- Clarity



Tips To Improve Prose

- Print it
- Read it aloud
- Cut the flab
- Strengthen verbs (active voice)
- Convert negatives to positives

Prepositions

The authors should perform new studies -- they have adequate material in their disposal.

Punctuation matters

- Woman without her man is a savage.
- Woman -- without her, man is a savage.

Use Simple Words

■ *Avoid*

- endeavor
- expired
- terminated
- initiate

■ *Use*

- try
- died
- ended
- begin

Misused Words/Terms

- criterion
- affect
- i.e.
- datum
- alternate
- level
- criteria
- effect
- e.g.
- data
- alternative
- Concentration/partial pressure/etc.

Omit Unnecessary Words

- very
- actual
- exceptionally
- most
- Quite
- recently (especially before a reference to an old paper)
- Clearly, ...

Level Is Often an Empty Word

- The serum glucose level was 10 mmol/L =
The serum glucose was 10 mmol/L.
- The PO_2 level was about 100 mm Hg =
The PO_2 was about 100 mm Hg.

Keep It Simple

- due to the fact that (because)
- in order to (to)
- subsequent to (after)
- at the present time (now)
- small in size (small)

Phrases To Omit

- It is well known that glucose is...
- It should be pointed out that glucose is...
- The level of pH was higher in group 2 than...
- It is becoming increasingly clear that the role of the laboratory will increase...
- Clearly, the role of the laboratory...

Use Active Verbs

- A study was conducted to determine...

vs

We conducted a study to determine...

- It is believed that...

vs

We believe that...

Improper Word Order

- He attacked the man with a smile on his face.

Split Infinitives Are No Longer Mortal Sins

- He vowed to vigorously promote exercising.
(Meaning is clear.)

EDITED VERSIONS:

- He vowed to promote exercising vigorously.
(Changed meaning)
- He vowed vigorously to promote exercising.
(Awkward, ambiguous meaning)

Can we do better?

- There is no doubt but that, at this point in time, the method has the ability to answer the question as to whether the level of glucose is above approximately 10 mg/mL.

Can we do better?

- There is no doubt but that, at this point in time, the method has the ability to answer the question as to whether the level of glucose is above approximately 10 mg/ml.
- **The detection limit is about 10 g glucose/L.**

More words to delete

- (already) existing
- (alternative) choices
- (basic) fundamentals
- (continue to) remain, (still) remains
- introduced (a new)
- period (of time)
- start (out)

Syntax

- I only tested the pump for leaks yesterday.
 - Only I tested the pump for leaks yesterday.
 - I tested only the pump for leaks yesterday.
 - I tested the pump only for leaks yesterday.
 - I tested the pump for leaks only yesterday.
-
- Don't be afraid to use “only if”:
 - I only made a table if the data were acceptable.
 - I made a table only if the data were acceptable

How To Write

- When reading papers, observe how good writers write – or even use a good paper as a model.
- Start writing any way you can.
 - Use structure of scientific paper as a guide.
 - Start manuscripts in the section with which you are most comfortable.
 - Get input: Co-authors, peers, mentors, editors...
- Plan on several drafts: 12 was not too painful.

Read/Observe

Write, Write, Write...

PRACTICE

Write, Write, Write...

Commit to a writing project
Writing courses

Thank you.

Suggested References

- American Medical Association. *Manual of Style*.
- Council of Biology Editors Style Manual.
- Uniform Requirements for Submission of Manuscripts. International Committee of Medical Journal Editors.
- STARD Checklist
- CONSORT

Most Creative and Challenging Form of Medical Communication



Medical Writing

- Research papers
- Case studies
- Review articles
- Chapters
- Reports, letters, charts
- Newsletters
- Lay press

Basic Requirements for a Good Article

- Simplicity
- Clarity

