

Readability tools: are they useful for medical writers?

John Dixon

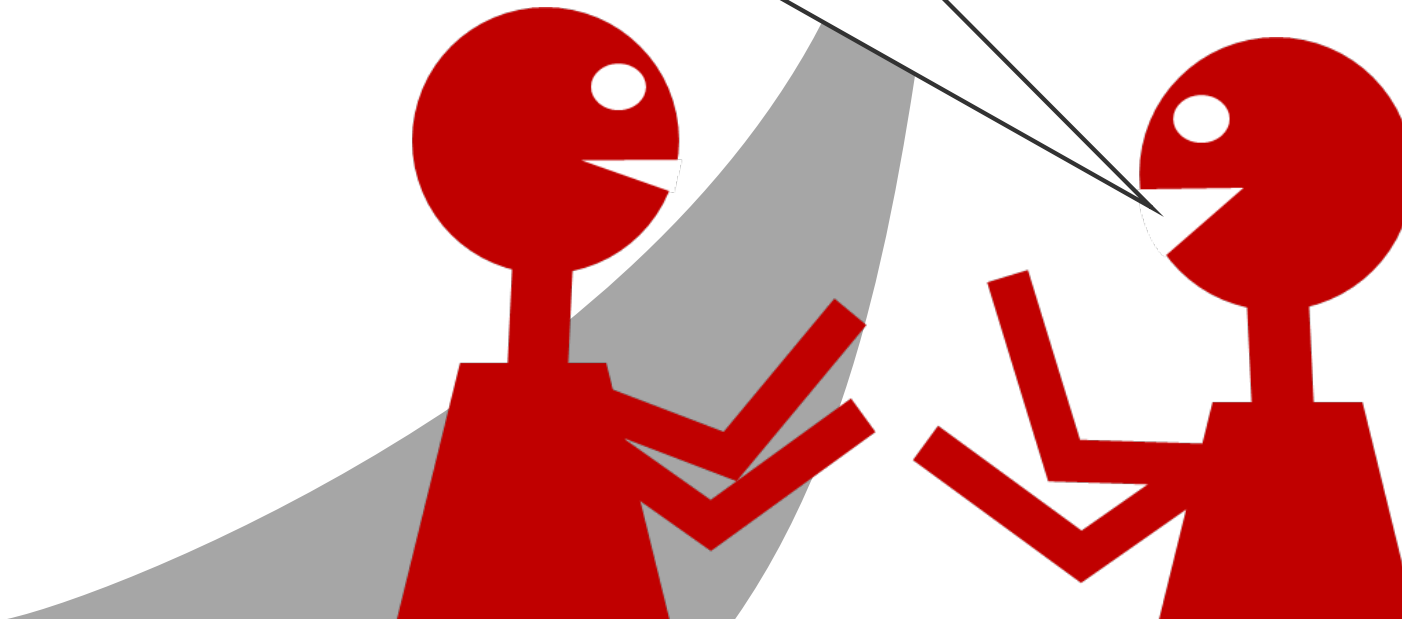
MedComms Networking Event, 4th October, 2017
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Libra
Communications
Training

MINISTRY OF GOBBLEDYGOOK

As I sincerely aspire to successfully secure employment within the boundaries of this establishment, do you presuppose that I possess the necessary competencies to achieve this inspirational objective?





Readability: definition

...“extent to which...[readers]...**understand**...[text]..., read it at an **optimum speed**, and find it **interesting**.”¹

...“the ease of...**comprehension** due to the **style of writing**”²

...“ease of reading **words** and **sentences**”³

1. Dale, E. & Chall, J. S. 1949. The concept of readability. In *Readability*. Edited by Dale, E. pp 1-7.

2. Klare, G. 1963. Cited by: DuBay, W. H. 2007. *Smart Language: Readers, Readability, and the Grading of Text*, Education Resources Information Center.

3. Hargis, G. *et al.* 1998. Cited by: DuBay, W. H. 2007. *Smart Language: Readers, Readability, and the Grading of Text*, Education Resources Information Center.

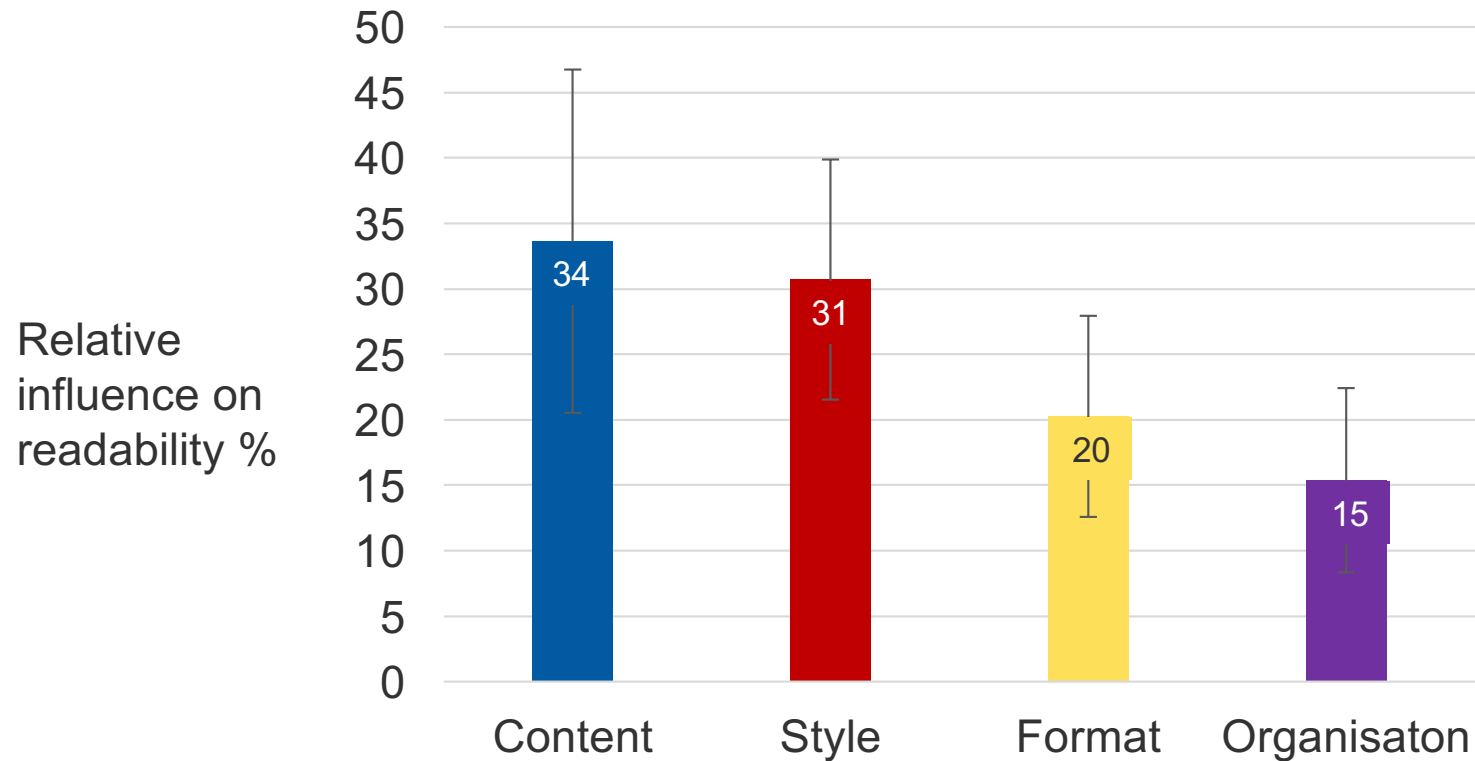


Readability: why is it important?

Delivering readable text means your writing will:

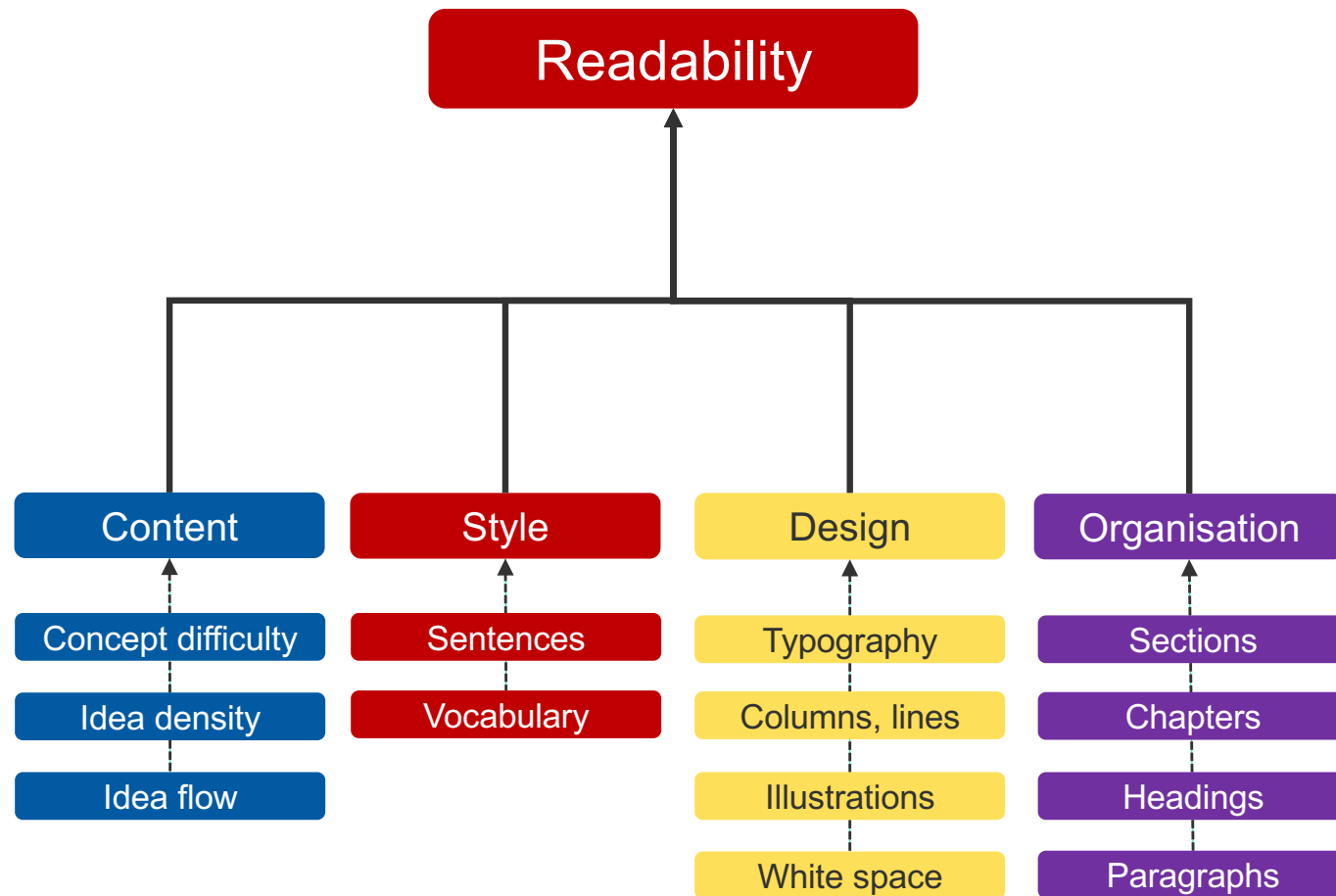
- Have greater impact
- Be understood more easily
- Help to increase the chance articles are published

Four major elements of readability

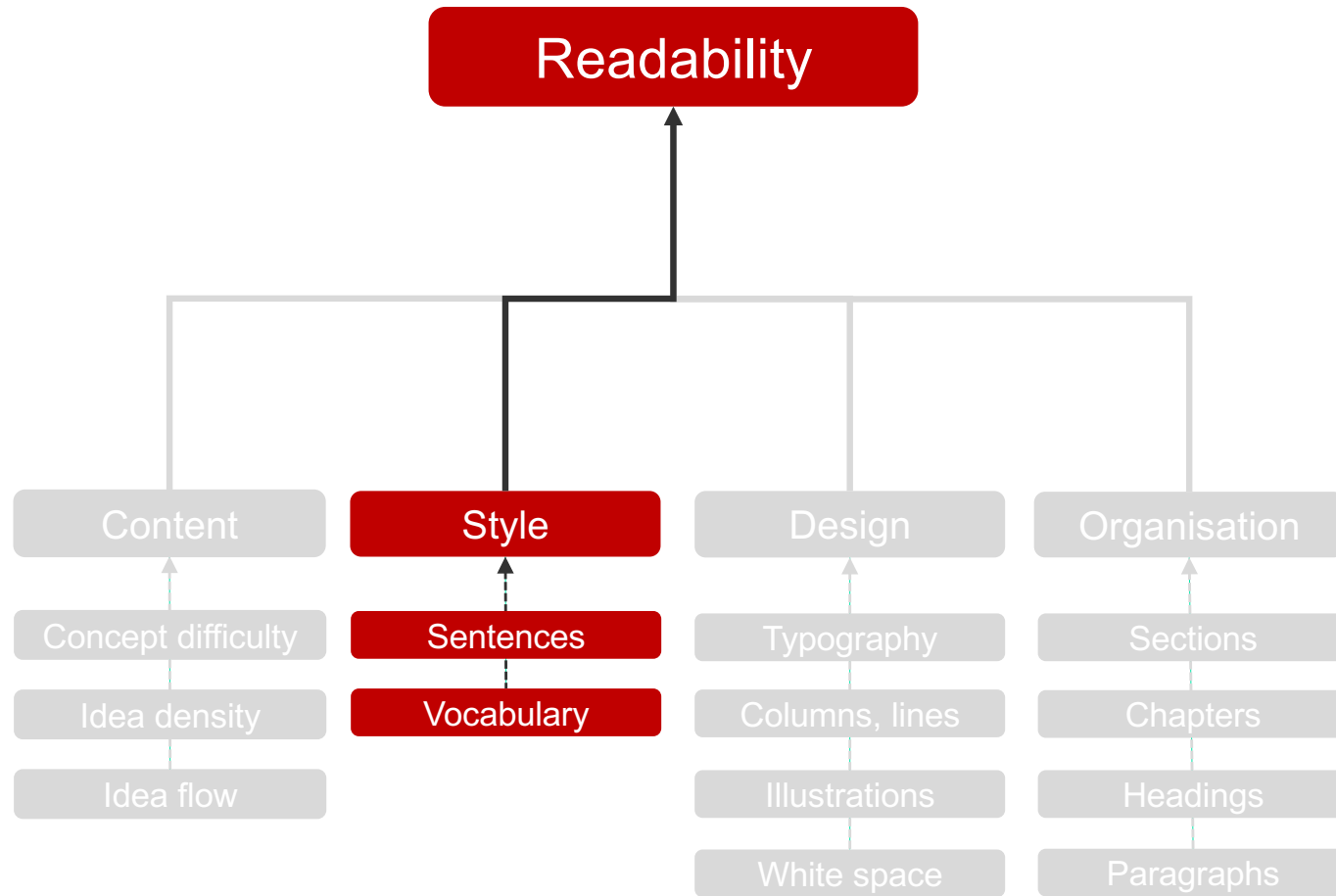


- 800 adults tested on range of material (books, magazines, newspapers)
- Of 228 elements affecting readability, 4 major elements were identified

Four major elements of readability



We can measure style





Two common formulas

- **Flesch reading ease** ('reading ease')
- **Flesch–Kincaid grade level** (education 'grade level')

Measure:

- Average words per sentence
- Average syllables per word

Used by:

- Microsoft Word and other tools to provide readability statistics



Flesch reading ease formula

Flesch reading ease

$$= 206.835 - 1.015 \left(\begin{array}{c} \text{average words} \\ \text{per sentence} \end{array} \right) - 84.6 \left(\begin{array}{c} \text{average syllables} \\ \text{per word} \end{array} \right)$$



Readability stats in Microsoft Word

PC: File / Options / Proofing / Spelling and Grammar

Mac: Word / Word Preferences / Spelling and Grammar

When correcting spelling and grammar in Word

- Check grammar with spelling
- Show readability statistics

AutoSave On Document1 - Word John Dixon

File Home Insert Design Layout References Mailings Review View EndNote X7 ACROBAT Tell me what you want to do

Spelling & Thesaurus Grammar ABC 123 Word Count Read Aloud Speech Proofing Check Accessibility Language Translate Language New Comment Delete Previous Next Show Comments Track Changes Reviewing Pane Accept Reject Previous Next Compare Block Authors Restrict Editing Linked Notes OneNote

To improve and maximise both clinical and cost efficiency, patients with selected medical problems traditionally seen by doctors in secondary care could frequently be managed by the UK National Health Service (NHS) in primary care. A general medical practitioner with special interest (GPwSI) possesses the capability to manage some patient referrals with certain conditions in a general practice setting rather the same work being undertaken by a consultant-led team in a hospital outpatient department (OPD). This paper documents an innovative new service model, supported by findings from an ear, nose and throat (ENT) clinic, instigated to manage a limited range of ENT conditions, and set up and run by a GPwSI in a general practice setting during an 18-month pilot study commencing April 2001. The aims of the investigation were to evaluate the clinical efficiency of the service, which is defined as the proportion of patients successfully managed without subsequent referral to secondary care, and the cost efficiency of the service, this defined as the amount saved per new patient referred. Further, a number of other service parameters were established, including pattern of referral, time taken to full capacity, mean delay to first appointment, attendance rate and overall patient satisfaction.

Page 1 of 1 200 words 180%



To improve and maximise both clinical and cost efficiency, patients with selected medical problems traditionally seen by doctors in secondary care could frequently be managed by the UK National Health Service (NHS) in primary care. A general medical practitioner with special interest (GPwSI) possesses the capability to manage some patient referrals with certain conditions in a general practice setting rather the same work being undertaken by a consultant-led team in a hospital outpatient department (OPD). This paper documents an innovative new service model, supported by findings from an ear, nose and throat (ENT) clinic, instigated to manage a limited range of ENT conditions, and set up and run by a GPwSI in a general practice setting during an 18-month pilot study commencing April 2001. The aims of the investigation were to evaluate the clinical efficiency of the service, which is defined as the proportion of patients successfully managed without subsequent referral to secondary care, and the cost efficiency of the service, this defined as the amount saved per new patient referred. Further, a number of other service parameters were established, including mean delay to first appointment, attendance rate and overall patient satisfaction.

Counts	
Words	201
Characters	1,108
Paragraphs	1
Sentences	5
Averages	
Sentences per Paragraph	5.0
Words per Sentence	40.2
Characters per Word	5.3
Readability	
Flesch Reading Ease	9.8
Flesch-Kincaid Grade Level	21.8
Passive Sentences	80.0%

Readability stats in Microsoft Word

Readability Statistics	
Counts	
Words	696
Characters	4,146
Paragraphs	4
Sentences	19
Averages	
Sentences per Paragraph	4.7
Words per Sentence	36.6
Characters per Word	5.8
Readability	
Flesch Reading Ease	4.5
Flesch-Kincaid Grade Level	21.2
Passive Sentences	52.6%
<input type="button" value="OK"/>	

Words per sentence

Flesch reading ease

Flesch-Kincaid grade level

Passive sentences %



Two common formulas

Formula	Output range	Units	Very easy reading	Very difficult reading
Flesch reading ease	100 to 0	—	90–100	0–29
Flesch–Kincaid grade level	5 to > 16	Education grade	5	> 16

Formulas: interpretation

Flesch reading ease	F–K grade level	Interpretation	Age	Educational institution	Examples	Average sentence length
90–100	5	Very easy	10	Elementary school	Comics	< 9
80–90	6	Fairly easy	11	Elementary school	Pulp fiction	11
60–70	9	Plain English	14	High school	Reader's Digest, The Sun	17
50–60	10	Fairly difficult	15	High school	New York Times	21
30–50	16	Difficult	21	University	Harvard Law Review	25

DuBay, W. H. 2007. *Smart Language: Readers, Readability, and the Grading of Text.*, Education Resources Information Center.

Fitzsimmons, P. R., Michael, B. D., Hulley, J. L., et al. 2010. A readability assessment of online Parkinson's disease information. *J R Coll Physicians Edinb*, 40, 292-6.

Wikipedia. Education in the United States [Online]. Available: https://en.wikipedia.org/wiki/Education_in_the_United_States. [Accessed 21 March 2017].

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- **Recommended grade level for patient education material is 6th grade**

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Fitzsimmons, P. R., Michael, B. D., Hulley, J. L., et al. 2010. A readability assessment of online Parkinson's disease information. *J R Coll Physicians Edinb*, 40, 292-6.

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- **Average adult reading level is 9th grade**

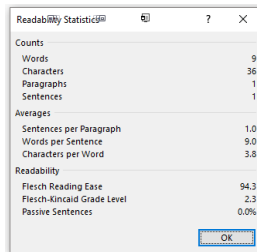
DuBay, W. H. 2007. *Smart Language: Readers, Readability, and the Grading of Text.*, Education Resources Information Center.

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Formulas ignore grammatical issues

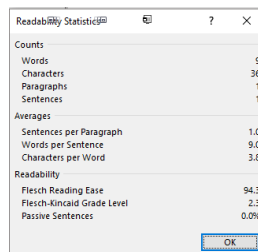
The quick brown fox jumps over the lazy dog.



Readability Statistics	
Counts	
Words	9
Characters	36
Paragraphs	1
Sentences	1
Averages	
Sentences per Paragraph	1.0
Words per Sentence	9.0
Characters per Word	3.8
Readability	
Flesch Reading Ease	94.3
Flesch-Kincaid Grade Level	2.3
Passive Sentences	0.0%

9 words: **FRE = 94.3; F–K grade level = 2.3**

Jumps the quick brown fox over dog the lazy.



Readability Statistics	
Counts	
Words	9
Characters	36
Paragraphs	1
Sentences	1
Averages	
Sentences per Paragraph	1.0
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Flesch Reading Ease	94.3
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Passive Sentences	0.0%

9 words: **FRE = 94.3; F–K grade level = 2.3**

Readability of biomedical journals

- Readability formulas were **not** primarily developed to measure the readability of scientific research articles
- So we need to appreciate what biomedical research articles score when using readability formulas

BJSMGP British Journal of Service Management
in General Practice

RESEARCH PAPER

Efficiency of a GPwSI ENT
clinic in general practice: an
18-month pilot

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Green

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Matching, Practice Nurse, Matching Surgery, Great
Matching. *Consultant ENT Surgeon, Eastbury ENT
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Acknowledgments
We would like to thank Eastbury NHS Trust
for agreeing to fund the pilot and for the
staff of Matching Surgery for their
contribution towards setting up and
administering the clinic.

Keywords
GPwSI, ENT, service model, cost efficiency,
clinical efficiency

Received
21 September 2001

Revised
15 January 2002

Accepted
13 April 2

Background and aims
To improve efficiency, the NHS encourages more work to be undertaken in primary rather than secondary care.¹ We
describe a promising new model of care. During an 18-month pilot ENT service run by a GP with Special Interest
(GPwSI) in general practice, we measured two major outcomes: clinical efficiency – the proportion of patients
successfully managed without subsequent referral to secondary care, and cost efficiency – the amount saved per new
patient referred to the service.

Methods
Local GPs were encouraged to refer patients to the new service. They were provided with guidelines listing conditions
that could safely be managed in general practice. Patients were seen in clinics initially held monthly, with additional
clinics added to cope with demand. Those that could not be safely managed in the clinic were referred to secondary
care. The amount saved was the difference between the cost of referring all patients to secondary care and the cost of
running the GPwSI clinic, less the cost of patients subsequently being referred. Other measures included: referral
patterns, time to full clinic capacity, mean delay to first appointment, non-attendance rate, and patient satisfaction by
questionnaire.

Results
Of 92 new patients seen, 87 (94.6%) were successfully managed without referral to secondary care. A saving of £58.04
was achieved per patient, representing a 36.3% saving on the hospital OPD rate of £160 per new patient (Table). The
mean delay to a new patient appointment was 2.1 (s.d. 1.4) weeks. Of 114 appointments allocated, 3 (2.2%) were not
attended. Of 73 patients completing a questionnaire, 65 (89%) were satisfied or very satisfied and 97.3% of patients
would recommend the service to others.

Conclusion
The clinic was simple to establish, easy to administer and patient satisfaction was reassuring. We hope this pilot
provides inspiration for further development of GPwSI services.

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(<http://creativecommons.org/licenses/by/3.0/>), which permits unrestricted use, distribution, and reproduction in any medium.



Readability of biomedical journals

- Flesch reading ease range: **15–32**
- Flesch–Kincaid grade level range: **16–19**

Hall, J. C. 2006. The readability of original articles in surgical journals. *ANZ J Surg*, 76, 68-70.

Hayden, J. D. 2008. Readability in the British Journal of Surgery. *Br J Surg*, 95, 119-24.

Kandula, S. & Zeng-Treitler, Q. 2008. Creating a gold standard for the readability measurement of health texts. *AMIA Annu Symp Proc*, 353-7.

Kumar, K. V., Aravinda, K. & Varadarajulu, R. N. 2013. The readability of editorials in popular Indian medical journals. *Indian J Endocrinol Metab*, 17, S363-6.

Roberts, J. C., Fletcher, R. H. & Fletcher, S. W. 1994. Effects of peer review and editing on the readability of articles published in *Annals of Internal Medicine*. *JAMA*, 272, 119-21.

Rochon, P. A., Bero, L. A., Bay, A. M., *et al.* 2002. Comparison of review articles published in peer-reviewed and throwaway journals. *JAMA*, 287, 2853-6.

Weeks, W. B. & Wallace, A. E. 2002. Readability of British and American medical prose at the start of the 21st century. *BMJ*, 325, 1451-2.

Formulas: interpretation

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0–29	> 16	Very difficult	> 22	Graduate	Biomedical journals	> 29



Readability of biomedical journals

Hall (2006):

“Original articles published in surgical journals contain too many long sentences and complex words. Readability indices are useful tools because they promote the use of simple English. It is realistic for authors to aim for Flesch scores [reading ease] above 30 when creating manuscripts.”



Formulas count everything!

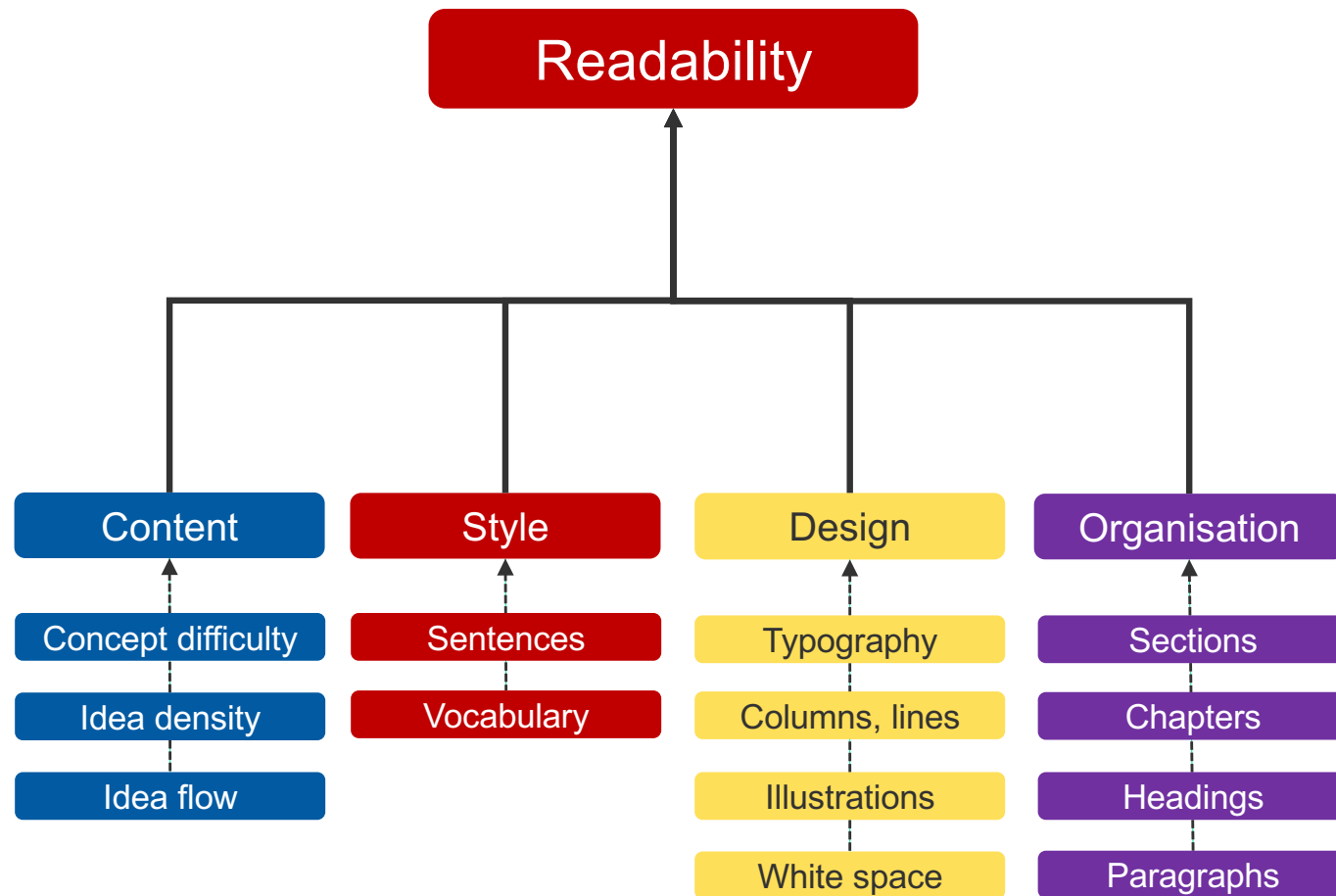
Formulas will also count:

- Author–date citations

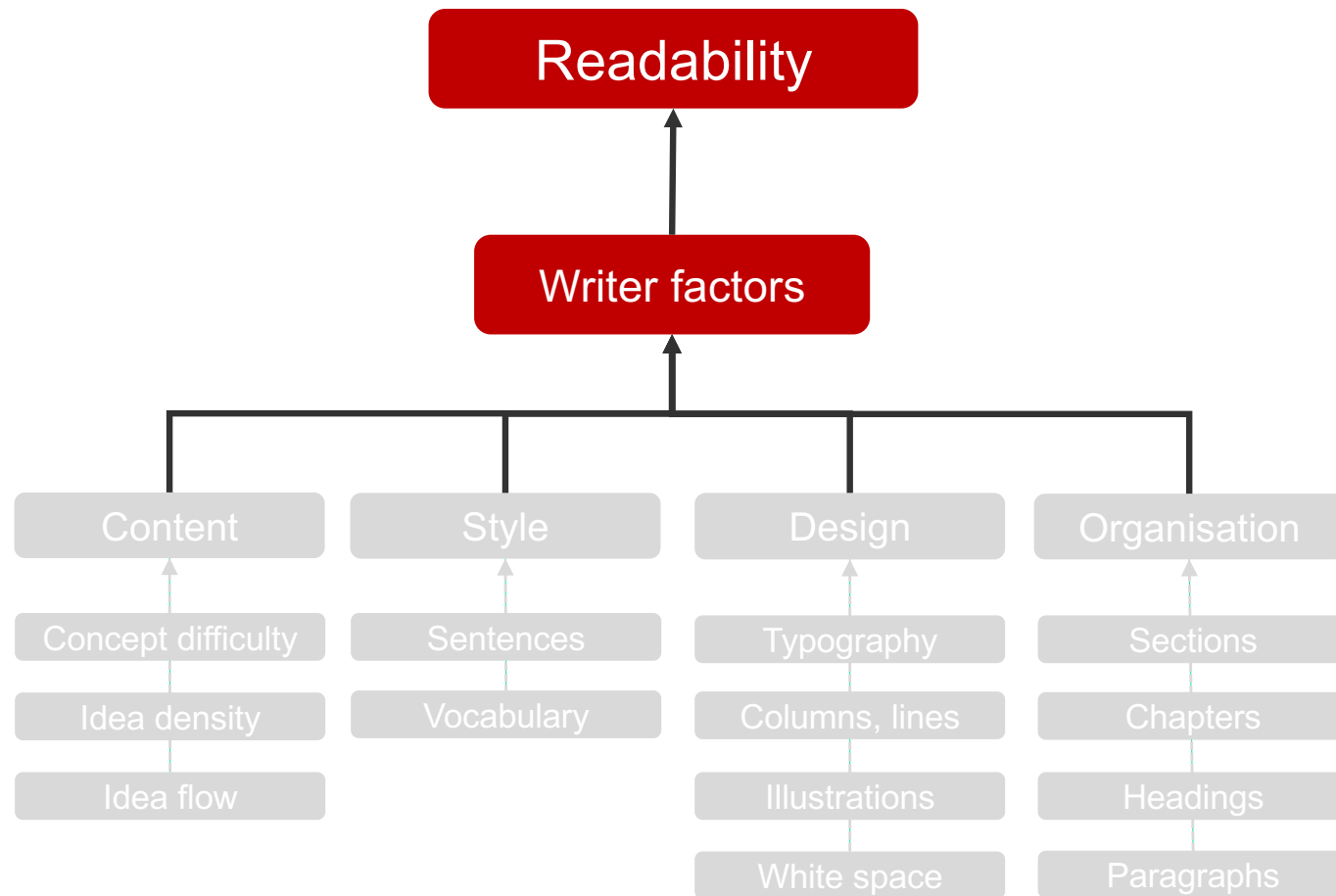
(Smith and Jones, 2017) = **4 words**

- Text and numbers in tables, graphs and reference lists
- Numbers used in body text, including statistics
- Equations

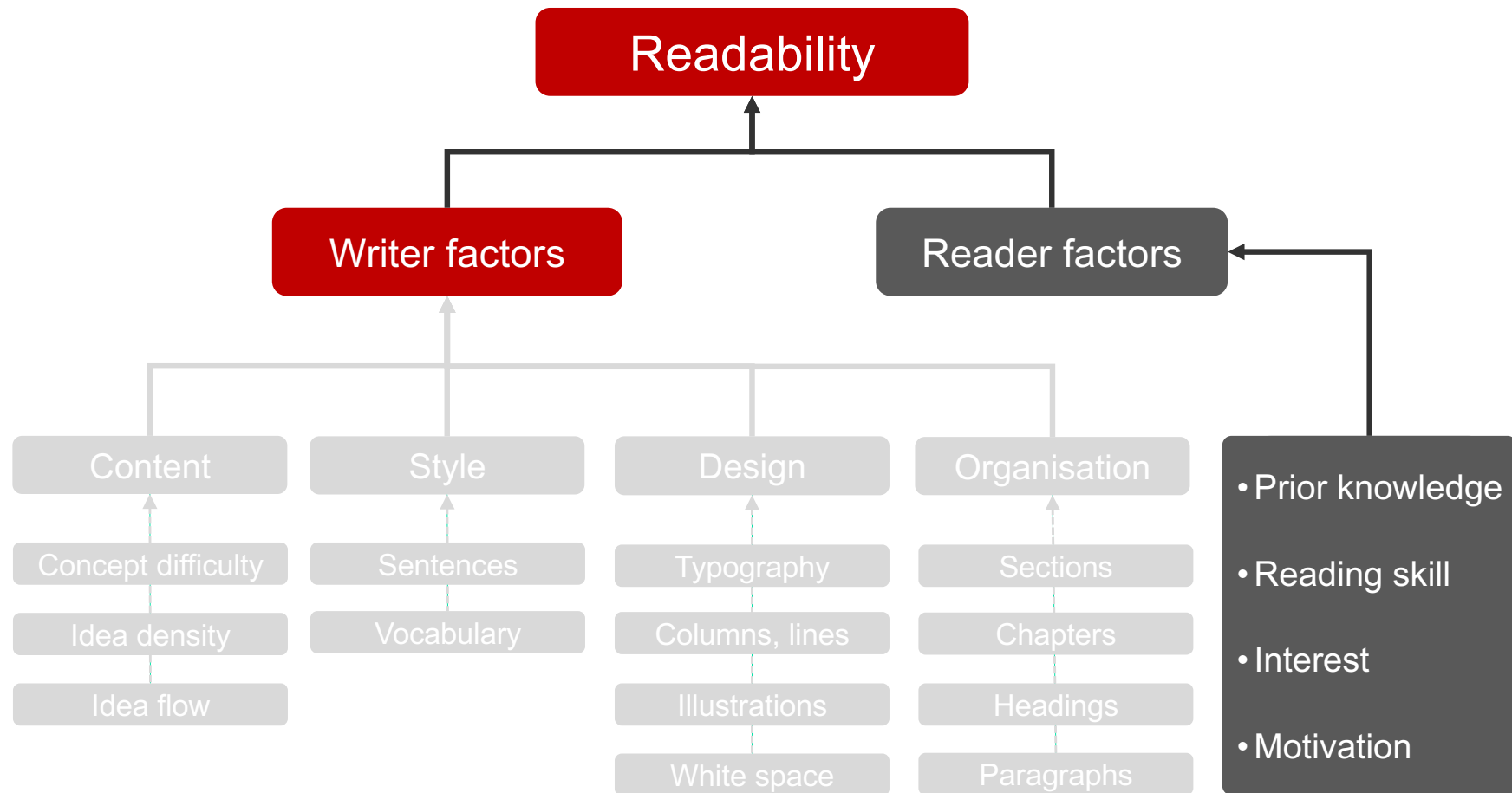
Four major elements of readability



Readability: writer and reader factors



Readability: writer and reader factors





Vocabulary issues

- Specialised, technical vocabulary may “artificially increase the number of ‘hard’ words”¹
- Word familiarity is more important than word length²

So, when editing biomedical text, simplify:

- Particularly long sentences
- Long/difficult, non-technical words

1. Rush, R. T. 1985. Assessing readability: Formulas and alternatives. *The Reading Teacher*, 39, 274-283.

2. Kauchak, D. & Leroy, G. 2016. Moving beyond readability metrics for health-related text simplification. *IT professional*, 18, 45-51. 27

Formula-derived statistics: pros

- Objective and quantifiable measure of style
- Rapid results via software/tools
- Can predict comprehension and inclination to read on
- Reader input not needed
- Can help writers improve simplicity of text
- Can be used as a **“warning”** tool



Formula-derived statistics: cons

- Can't measure:
 - quality of grammar
 - content, format and organisation
 - reader factors: interest, reading skill, prior knowledge, motivation
 - audience understanding – particularly for specialised audience
- Writing 'to the formula' may not improve readability
- Variation between formula results



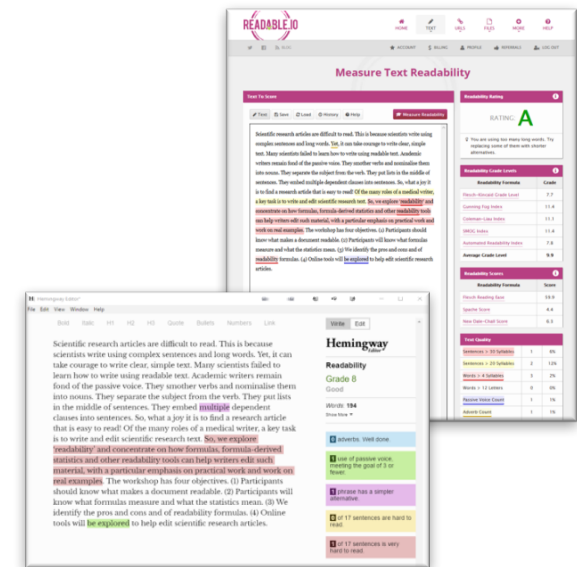
Online readability tools: scope

Provide readability statistics:

- Calculate scores from a range of formulas
- Calculate average readability score

Highlight difficult text (a visual analysis):

- Long/difficult sentences
- Long/difficult words¹
- Words that could be simplified²
- Use of passive voice
- Adverbs



1. Readable.IO. Available from: <https://readable.io>
2. Hemingway Editor. Available from: <http://www.hemingwayapp.com/desktop.html>

Hemingway Editor*

File Edit View Window Help

Bold Italic H1 H2 H3 Quote Bullets Numbers Link

Write Edit

Hemingway Editor

Readability

Grade 9
Good

Words: 195
Show More ▾

- 1 adverb. Aim for 0 or fewer.
- 1 use of passive voice, meeting the goal of 3 or fewer.
- 1 phrase has a simpler alternative.
- 1 of 15 sentences is hard to read.
- 1 of 15 sentences is very hard to read.

Scientific research articles are difficult to read. This is because scientists write using complex sentences and long words. Yet, it can take courage to write **really** clear, simple text. Many scientists failed to learn how to write using readable text. Academic writers remain fond of the passive voice. **They smother verbs and nominalise them into nouns, separate the subject from the verb and put lists in the middle of sentences.** They embed **multiple** dependent clauses into sentences. So, what a joy it is to find a research article that is easy to read! Of the many of roles of a medical writer, writing and editing research text is one of the key challenges. **So, we explore 'readability' and concentrate on how formulas, formula-derived statistics and other readability tools can help writers edit such material, with a particular emphasis on practical work and work on real examples.** The workshop has four objectives. (1) Participants should know what makes a document readable. (2) Participants will know what formulas measure and what the statistics mean. (3) We identify the pros and cons and of readability formulas. (4) Online tools will **be explored** to help edit scientific research articles.

Measure Text Readability

Text To Score

[Text](#)
[Save](#)
[Load](#)
[History](#)
[Help](#)
[Measure Readability](#)

Scientific research articles are difficult to read. This is because scientists write using complex sentences and long words. Yet, it can take courage to write really clear, simple text. Many scientists failed to learn how to write using readable text. Academic writers remain fond of the passive voice. They smother verbs and nominalise them into nouns, separate the subject from the verb and put lists in the middle of sentences. They embed multiple dependent clauses into sentences. So, what a joy it is to find a research article that is easy to read! Of the many of roles of a medical writer, writing and editing research text is one of the key challenges. So, we explore 'readability' and concentrate on how formulas, formula-derived statistics and other readability tools can help writers edit such material, with a particular emphasis on practical work and work on real examples. The workshop has four objectives. (1) Participants should know what makes a document readable. (2) Participants will know what formulas measure and what the statistics mean. (3) We identify the pros and cons and of readability formulas. (4) Online tools will be explored to help edit scientific research articles.

Readability Rating

RATING: **B**

You are using too many long words. Try replacing some of them with shorter alternatives.

Readability Grade Levels

Readability Formula	Grade
Flesch-Kincaid Grade Level	8.5
Gunning Fog Index	12.4
Coleman-Liau Index	11.5
SMOG Index	12.2
Automated Readability Index	8.7
Average Grade Level	10.7

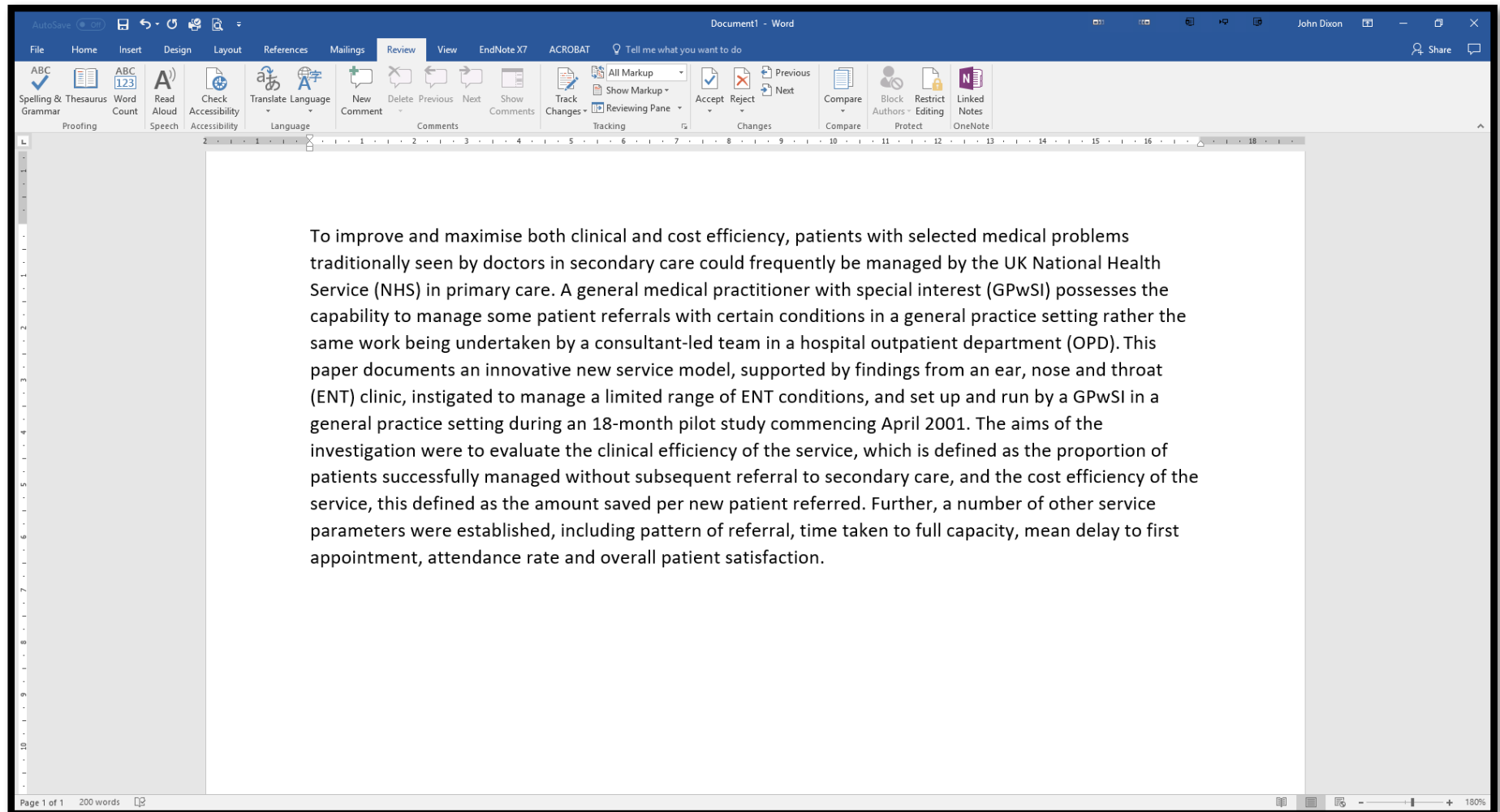
Readability Scores

Readability Formula	Score
Flesch Reading Ease	56.8
Spache Score	4.7
New Dale-Chall Score	6.3

Text Quality

Sentences > 30 Syllables	2	13%
Sentences > 20 Syllables	3	20%
Words > 4 Syllables	3	2%
Words > 12 Letters	0	0%
Passive Voice Count	1	1%

Unedited text for Client X



The image shows a screenshot of the Microsoft Word application interface. The 'Review' tab is active in the ribbon, displaying various tools for proofing and editing. The main document area contains a single paragraph of text. The status bar at the bottom indicates 'Page 1 of 1' and '200 words'.

To improve and maximise both clinical and cost efficiency, patients with selected medical problems traditionally seen by doctors in secondary care could frequently be managed by the UK National Health Service (NHS) in primary care. A general medical practitioner with special interest (GPwSI) possesses the capability to manage some patient referrals with certain conditions in a general practice setting rather than the same work being undertaken by a consultant-led team in a hospital outpatient department (OPD). This paper documents an innovative new service model, supported by findings from an ear, nose and throat (ENT) clinic, instigated to manage a limited range of ENT conditions, and set up and run by a GPwSI in a general practice setting during an 18-month pilot study commencing April 2001. The aims of the investigation were to evaluate the clinical efficiency of the service, which is defined as the proportion of patients successfully managed without subsequent referral to secondary care, and the cost efficiency of the service, this defined as the amount saved per new patient referred. Further, a number of other service parameters were established, including pattern of referral, time taken to full capacity, mean delay to first appointment, attendance rate and overall patient satisfaction.

Unedited text for Client X

MS Readability Statistics

Words	201
Sentences	5
Words per sentence	40.2
Flesch Reading Ease	9.8
Flesch-Kincaid Grade Level	21.8
Passive Sentences	80%

The screenshot shows a Microsoft Word document with the following text:

To improve and maximise both clinical and cost efficiency, patients with selected medical problems traditionally seen by doctors in secondary care could frequently be managed by the Unedited text for Client X Service (NHS) in primary care. A general medical practitioner with special interest (GMI) possesses the capability to manage some patient referrals with certain conditions in a general practice setting rather than the same work being undertaken by a consultant-led team in a hospital outpatient department (OPD). This paper documents an innovative new service model, supported by findings from an ear, nose and throat (ENT) clinic, instigated to manage a limited range of ENT conditions, and set up and run by a GPwSI in a general practice setting during an 18-month pilot study commencing in 2001. The aims of the investigation were to evaluate the patients successfully managed with service, this defined as the amount of service, and the cost efficiency of the service, a number of other service parameters were established, including appointment, attendance rate and full capacity, mean delay to first

The 'Readability Statistics' dialog box in the Word window displays the following data:

Counts	
Words	201
Characters	1,108
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Sentences	5
Averages	
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Words per Sentence	40.2
Characters per Word	5.5
Readability	
Flesch Reading Ease	9.8
Flesch-Kincaid Grade Level	21.8
Passive Sentences	80.0%

Hemingway Editor*

File Edit View Window Help

Bold Italic H1 H2 H3 Quote Bullets Numbers Link

Write Edit

Hemingway Editor

Readability

Post-graduate
Poor. Aim for 14.

Words: 200
Show More ▾

- 3 adverbs. Aim for 0 or fewer.
- 3 uses of passive voice. Cut to 1 or fewer.
- 4 phrases have simpler alternatives.
- 0 of 5 sentences are hard to read.
- 5 of 5 sentences are very hard to read.

To improve and maximise both clinical and cost efficiency, patients with selected medical problems traditionally seen by doctors in secondary care could frequently be managed by the UK National Health Service (NHS) in primary care. A general medical practitioner with special interest (GPwSI) possesses the capability to manage some patient referrals with certain conditions in a general practice setting rather the same work being undertaken by a consultant-led team in a hospital outpatient department (OPD). This paper documents an innovative new service model, supported by findings from an ear, nose and throat (ENT) clinic, instigated to manage a limited range of ENT conditions, and set up and run by a GPwSI in a general practice setting during an 18-month pilot study commencing April 2001. The aims of the investigation were to evaluate the clinical efficiency of the service, which is defined as the proportion of patients successfully managed without subsequent referral to secondary care, and the cost efficiency of the service, this defined as the amount saved per new patient referred. Further, a number of other service parameters were established, including pattern of referral, time taken to full capacity, mean delay to first appointment, attendance rate and overall patient satisfaction.

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Text Save Load History Help Measure Readability

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Readability Rating

RATING: **E**

To improve your readability, try using shorter sentences and simpler words where possible.

Readability Grade Levels

Readability Formula	Grade
Flesch-Kincaid Grade Level	21.4
Gunning Fog Index	25.6
Coleman-Liau Index	15
SMOG Index	21
Automated Readability Index	23.9
Average Grade Level	21.4

Readability Scores

Readability Formula	Score
Flesch Reading Ease	13.1
Spache Score	8.6
New Dale-Chall Score	8.2

Text Quality

Sentences > 30 Syllables	5	100%
Sentences > 20 Syllables	5	100%
Words > 4 Syllables	3	2%
Words > 12 Letters	2	1%
Passive Voice Count	4	4%
Adverb Count	4	2%

Screening text for readability

Readability statistics and tools can be used to screen any text you have edited:

- Biomedical research articles
- Patient education material
- Training material
- Website text
- Blogs...





Screening biomedical research text

From a completed draft, it's best to remove:

- Author–date citations
- Tables, graphs and reference list
- Equations



Screening biomedical research text

- In MS Word, use the Readability Statistics tool to establish:

Flesch Reading Ease low values e.g. **< 20** suggest readability could be improved

Flesch–Kincaid Grade Level high values, e.g. **> 16** suggest readability could be improved

Average words per sentence if approaching **30**, some sentences could be too long

Passive sentences % if **> 40%**, consider rewriting some in the active voice



Screening biomedical research text

- Try other readability tools to highlight:

Problem sentences	consider simplifying long, complex sentences
Long words	is a shorter alternative available/appropriate?
Passive voice	consider rewriting in the active voice, if appropriate
Adverbs	needed?



Conclusions

- Readability formulas usually measure average sentence length and word difficulty
- Other tools can identify long sentences, long words, difficult words, use of passive voice and adverbs
- Readability tools can be used to **screen** biomedical research articles and any other written material – to help editors improve readability

BUT

- Use other well-documented advice to help improve readability!



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Thank you

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