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Doing science

Getting the word out: how to talk to the public about your research

Historically, science and medicine have been almost completely inaccessible to patients and the general public. This divide was created by many issues, including inequalities in access to education, latinised language, invitation-only academic societies and closed journals.

In many developed nations, this situation began to change with the advent of national education, alongside other societal changes including increased rights for marginalised groups, printed press, public libraries, improved literacy levels and more leisure time. These societal shifts and improvements in technology paved the way for the advent of the information age [1], in which widespread computer literacy and internet access started to break down the barriers between academia and the rest of society.

The rate of publication of academic papers has increased exponentially [2], fuelled by greater investment in research, the transition from print to online publishing and the notion of "publish or perish" [3]. Open access publications, greater press coverage and even pirating of academic papers means that more people than ever have access to scientific publications. It also means that patients can learn more about their conditions independently of their healthcare providers.

Many of the changes described so far confer direct benefits but the rate at which they have occurred has meant that there has not been a lot of time to understand and address the drawbacks of readily available research. One thing that is clear is that misinterpretation is common [4], as the skills needed to critically evaluate scientific studies and evaluate findings in light of previous research are not widely held.

In light of the age of information, and the benefits and risks it brings, people working in science and medicine have a shared responsibility to make science accessible to the public and to empower them to understand more. However, they also need to protect scientific evidence from misinterpretation. Learning how to proactively communicate research for the benefit of the general public is key to safeguarding against misinformation and could help researchers to direct the narrative of their findings in the public sphere.

In this article, we will cover some of the many and varied benefits of accessible communication, and address actual and perceived barriers to writing for and speaking to nonspecialist audiences. We will also work through several different tips and strategies for communicating to the general public, and how to use the correct tools to disseminate what you have produced effectively to increase impact and benefit ultimate stakeholders in your research.

Benefits of communicating effectively to nonspecialist audiences

Aside from protecting your results from conscious or unconscious misinterpretation, learning how to communicate findings more broadly has a wide range of benefits for researchers. Increasingly, "lay"

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Communicating to nonspecialist audiences about research has many benefits for both scientists and clinicians. By using techniques and tools for accessible communication, it is possible to convey complex topics in a clear, engaging and sensitive manner. http://bit.ly/39M1oym

reviewers are being used in research grant panels and as the ultimate stakeholder in medical research, their views are rightly valued [5]. These reviewers are also involved in decision panels for other academic awards, as well as conference abstracts and ethics committees. It is important to be able to communicate accurately, sensitively and, above all, accessibly for this audience.

In addition, communicating research proactively to the general public is part of an effective dissemination strategy and directly increases the impact of that research. This benefit is realised through various mechanisms, including attracting the attention of the news media and encouraging local community engagement. Accessible communication skills can also help researchers to advocate for policy change, which is particularly relevant to those working in medical fields.

There are other less direct benefits too. For example, talking to a broader audience about research could encourage children and young people to consider a career in science or medicine, talking to patients and other stakeholders to understand the current state of play in their disease area could raise new research questions, and greater visibility could lead to important collaboration opportunities.

Finally, protecting against the spread of misinformation is a critical function of careful public communication. A skilled science communicator can help to limit the risk to public health from pseudoscience, promote public trust in evidence-based medicine and positively influence behaviour change to improve quality of life.

What is nonspecialist communication?

To realise the various benefits of accessible communication, it is first necessary to understand what is and is not accessible. Throughout this article, the following definition is used:

Accessible communication is writing or speech that is specifically designed for a nonspecialist or general audience. This may include people with little or no professional or academic knowledge of the specified field, and/or of science in general.

The definition above is inclusive of communication designed for patients, who may have a great amount of knowledge about their own condition but still benefit from accessible communication. It is also inclusive of academics and professionals who work in other fields, as well as children, people with learning difficulties and disabilities, older people, journalists, policy makers, and many other groups of people with a wide range of different needs. Therefore, the approach will need to vary depending on the interests, background, reading age and comprehension capability of the audience in question.

Readability

One way of determining whether written material is understandable for a general audience is to measure its readability. Measuring readability is an important evaluation tool and, by their nature, the determining variables shown in table 1 are important principles in creating communications for nonspecialist audiences.

There are a variety of different available measures and the outcome is most commonly expressed in years (and is therefore often referred to as reading age) or grade (typically relating to the American education system). The measures listed in table 1 include some of the simpler readability tools, as well as the measures that are most often included in word processing software and online applications.

It is frequently stated that the average reading age of the general public is 8–10 years [9] but this assumption is not always useful or directly measureable. There is a huge variability in the reading ability of children aged 8–10 years and even if this is defined as the expected reading ability for someone in this age group, this will vary between educational systems. It is more useful to compare text to other text that might be read by the intended audience using readability measures like those detailed in table 1.

When using a readability measure, it is important to take note of its determining variables. Most incorporate word and sentence length but there

Table 1 *A description of some of the most commonly used readability measures with their determining variables and outputs [6–8]*

Readability measure	Determining variables	Output
Flesch reading ease/age	Sentence length Length of words (in syllables)	A score out of 100 (where lower scores indicate more difficult text) and/or reading age
Flesch–Kincaid grade level	Sentence length Length of words (in syllables)	US educational grade, or the number of years of education generally required to understand the text
Gunning fog index	Average sentence length Prevalence of words that are more than two syllables	US educational grade, or the number of years of education generally required to understand the text

are many different components to readability, so it is a good idea to also assess readability through interactive online tools [10] and by applying knowledge of what makes text easier to read or understand.

Indeed, although reading age is useful for comparing texts, it is less useful as communications are being developed, as simply shortening sentences and words is rarely enough. In some circumstances, writing or heavily editing to achieve a certain reading level or grade can make the text more difficult to read, as the natural flow of sentences is disrupted. Therefore, it is recommended that readability measures are used as one tool of many, rather than blindly relied upon to produce accessible communications.

Features of accessible communication

There are three major features of accessible communication.

1) Avoid complex words or jargon

One of the features that is most obviously missing from most readability measures is word choice. In any text, technical jargon tends to be easy to identify but writers must also be aware of general scientific jargon that may not be clear for their audience (*e.g.* "significant", "cohort" and "interaction"). Writers should also actively substitute more complex words or phrases for simpler choices wherever possible.

2) Be mindful of sentence length and structure

Sentence structure and length can vastly alter the clarity of a piece of text. Using active sentences and keeping sentences short and simple makes texts more readable and is particularly important to keep readers engaged.

The structure of nonspecialist communication is also very different to that of an academic text. In academia, it is expected that authors introduce their subject in a broad manner, providing the context and background first, before narrowing down to methods, relevant results and conclusion. For more accessible writing, it is better to start with the conclusion, which engages the readers' interest, before moving on to provide some contextualising information and then summarising. One of the best examples of this are news bulletins, which typically take the format: headline, story, headline.

3) Engage your audience and be sensitive

Although this article mainly focuses on writing accessibly, communication for the general public is also about writing in a way that engages the audience. This could mean simply keeping the audience's attention throughout the communication but it could also include encouraging readers to take a particular point of view, raising awareness or encouraging them to change their behaviour. Finally, researchers and professionals working in the field of medicine must develop skills in communicating sensitively about their work.

Barriers to writing accessibly

Many people believe that some topics are too complicated to explain to a general audience. However, any topic can be explained in a simple way, particularly if the fine detail is not essential for comprehension.

Communicating for a general audience necessitates writing succinctly. One way of substantially condensing the volume of words needed is writing in an active voice (an example of this is given in a later section), which helps readers to stay with the narrative for long enough to grasp key points.

So, while it is not likely that someone can become well versed in a particular field of science from a short communication, there is a good chance that well-crafted content can relay the most critical points of a summary or argument.

One of the more difficult barriers to navigate is developing two succinct writing styles. Most academics have trained themselves to write in a style that is very specific for academic publications. This style is typified by long sentences, passive sentence structure and using all the key terms needed in their field.

An academic writing style can be particularly difficult to break away from for non-native English speakers. When English is only used academically, it is not as easy to practice conversational English, which has many more similarities to accessible communication than academic English. It follows, then, that the best way to overcome these barriers is to practice communicating for varying audiences.

How to write for the general public

In the following sections, features of lay communication are described with examples. However, it should be noted that none of the following features can function independently, so should be used together in accessible writing.

Active language

Active language is one of the most important features of nonspecialist communication. Here is an example of a simple active sentence:

The cat sat on the mat.

This sentence is active because the subject (the cat) goes before the verb (sat), which is followed by the object (the mat). In a passive version of this sentence, the object and subject are reversed:

> The mat was sat on by the cat.

This sentence is longer and more difficult to understand. This may be because the reader must retain knowledge about the object (which is often less memorable) throughout the sentence or because passive sentences are so uncommon in other parts of life. Passive writing can also take the form of sentences without subjects. For example:

> The mat was sat on.

Writing passively without referring to the subject of sentences can be useful if the author wishes to avoid referring to themselves. This one of the reasons that these sentences are so commonly seen in academic papers, so much so that any methods section that included sentence subjects would be very unexpected.

The difference between active and passive sentences becomes even more apparent when looking at active and passive versions of longer pieces of text. For example:

> The airway may become obstructed by an intraluminal mass such as a foreign body or tumour, in which case, surgical resection is often curative.

can be compared with:

> An intraluminal mass (such as a foreign body or tumour) may obstruct the airway. In this case, the condition may be cured surgically.

In this example, the active version (the first sentence) is substantially clearer than the second. However, the two versions are more difficult to differentiate because the subject and object are a little harder to distinguish.

Active *versus* passive tone

The position of the subject in relation to the verb defines whether a sentence is active or passive. However, sentences can also have other passive features, which should be avoided in lay communications. Features of a passive tone include turning verbs into nouns, overuse of the word "the", and overly complex and lengthy sentences. Consider the following sentence:

> Bronchiectasis can be characterised by the development of chronic cough with mucus production.

As well as changing the structure of the sentence to make it active, the author should consider the parts of the sentence that contribute to its passivity.

This helps condense the sentence into something that is much more understandable:

> A chronic cough and excess mucus characterise bronchiectasis.

Writing actively is essential for accessible communication and can be a tricky skill to master consistently. Once active language starts to become more intuitive, other lay communication skills are much easier to incorporate.

Short sentences

Shorter sentences are easier to read because less information has to be retained at one time. Aiming for a sentence length <10 words will help to clarify your message. There are two ways to use shorter sentences when writing.

Splitting up longer sentences is the easiest way to achieve short, clear sentences, even if this means adding a few words to the passage to achieve two stand-alone sentences. Wherever possible, authors should keep sentences to one subject–verb–object construction.

The writer can also shorten sentences by adapting their writing and editing iteratively in favour of shorter constructions. Many people who have written to strict word counts will be familiar with this process and it is often surprising how much shorter a sentence can become when this process is applied. The following example shows how both splitting up a sentence and substituting simpler constructions where possible results in a much clearer message:

> Variant infectious causes have been defined, being viral or bacterial in nature, and humans enter in contact with these pathogens principally *via* direct contact.

> We have defined viral and bacterial pathogens. Humans are exposed to these pathogens *via* direct contact.

Punctuation should be used to control the rhythm of sentences or make necessarily longer sentences easier to understand. Parentheses and bullet pointed lists are good examples of this technique.

Word choice

Vocabulary is the feature that many academics think of first when considering writing for a general audience. However, on its own, word choice is insufficient to convert academic language to accessible language. Indeed, focussing on word choice too much can lead to thinking that some topics are too complicated for a lay audience, as simpler terms are not available in many situations (*e.g.* gene variants, certain anatomical features and pharmaceuticals). However, there are a few different techniques to simplify the words used to describe complex concepts.

Firstly, necessary jargon can be explained in text without too much disruption, so long as the writer does not enter into too much detail. For example:

> Radiotherapy, a treatment that uses radiation to destroy cancer cells…

One of the strengths and challenges of the English language is that a huge proportion of words have at least a couple of different alternatives, each varying in commonality and clarity. Writers should substitute unnecessarily complicated language. This usually means choosing alternatives that have less syllables and are more commonly used in an everyday setting.

Words with fewer syllables are easier to understand, and can make a sentence seem simpler and even more impactful if used correctly. Words that are four syllables or more, and not commonly used by people who are not specialists or professionals should be avoided. Often, there is no loss in meaning when words are changed for simpler variants. For example, "utilise" can become "use", "associated" can be replaced with "linked" and "objective" can be substituted with "goal".

However, there are many examples of words with fewer syllables that are less commonly used and *vice versa*. A good example for this principle is the word "diagnosis". Although it is a long word at four syllables, it is used often enough for the vast majority of the general public to be able to understand. Any word of this length that is less commonly used should be avoided in nonspecialist communication unless it is explained when it is first introduced.

Overuse of adjectives

Adjectives are a marker of less-accessible language but are often used to keep text under a certain word count. Using multiple adjectives in a row can make a sentence particularly difficult to understand and should be avoided even where word count is restrictive, as illustrated in the following examples:

> Both gaseous and particulate airborne pollutants can contribute to chronic, severe, respiratory conditions in neonates.

Adjective use can be minimised by removing unnecessary adjectives and expanding out necessary adjectives to avoid "runs" of descriptors before nouns. Authors can further clarify meaning and add impact by carefully selecting adjectives to discard and expand, as in the following example:

> Both gaseous and particulate pollutants can contribute to respiratory conditions in neonates. These conditions are often chronic and severely debilitating.

Structure

As mentioned earlier in this article, the structure of academic communications including papers is not appropriate for a general audience. This is because the take-home message is buried in academic texts, after the subject has been introduced and the methods have been described. For the purposes of nonspecialist communication, it is better to begin with the take-home message. This can then be followed up with key background information and context.

This general principal can be adapted to the purpose of the text but ensures that the reader's attention is captured from the beginning, and does not necessitate reading of the full text for comprehension. Another advantage is that by repeating the key message (*e.g.* in the title, introduction and summary), it is more likely to be retained by the reader.

Aside from the positioning of the key message, an accessible structure should be clear to follow. To achieve this in longer texts, it is useful to devote a paragraph to talking about what you will cover. This helps with comprehension and reader retention throughout the text.

Each paragraph or section should cover just one concept and particular attention should be paid to the transitions between paragraphs, which should be as smooth as possible to avoid jarring the reader. This can be achieved by using conjunctions and by referring to the preceding or succeeding paragraph as appropriate.

The conclusion of an accessible text can be made more memorable or poignant by relating the topic back to the reader. This could take the form of a call to action, a signpost on to other helpful information or resources, or information about how the key message could change their circumstances.

Formatting

When aiming for accessibility, it is helpful to pay attention to the formatting as well as the content of your text. Breaking up text into short paragraphs and incorporating more white space by increasing line and word spacing can make even long texts seem more readable.

Other ways to improve the readability of text through formatting include:

- using larger font sizes
- ensuring adequate contrast (*e.g.* black text on a white background)
- incorporating relevant images where possible
- breaking up text with subheadings
- using bullets in place of long lists
- keeping text aligned to the left (rather than justified which creates inconsistent word spacing)

Writing to engage a nonspecialist audience

In the absence of a professional or academic interest, a general audience has less tolerance for

communications that are not engaging. One of the most important ways of keeping an audience's interest is to make sure that the topic is relevant to them. However, there are other ways to increase engagement, which can be particularly useful when trying to connect with a broad audience or encourage interest in a novel topic.

Keeping writing concise is the first thing to consider, as it makes it easier to keep the reader's attention for the whole text. This can be achieved by simplifying the message, and then applying many of the techniques described above in "How to write for the general public".

Keeping sentence length varied is another way to keep the reader's attention and applied whether communicating through writing or speech. This is because it mirrors spoken language, where some phrases are short and others long. However, this should not come at the expense of clarity, so writing sentences that are overly long is discouraged.

A lively and engaging tone can be achieved through use of rhetorical questions and by using verbs to their full extent. This could include starting sentences and subheadings with verbs or turning nouns into verbs where possible as part of active sentences (*e.g.* "treating cancer" rather than "the treatment of cancer").

Finally, writers can promote engagement by breaking the usual rules of grammar and using language creatively, particularly when writing for a less formal purpose. This could include starting sentences with prepositions (*e.g.* "But did you know that...?") using alliteration (*e.g.* "How to stop smoking sooner") and making use of idioms if the audience has a good degree of fluency in the language that is being used.

Writing conscientiously for a general or patient audience

Although writing informally and with the intention to engage has its place, there are many situations in which communicating conscientiously is more important. This is particularly important when communicating about medical topics to a nonspecialist audience. If writing offends or patronises, even to a minor degree, it is not achieving its purpose.

When writing, the audience can seem very distant, which makes it easier for unintentionally offensive terms and phrases to make it into text. Therefore, it is useful to imagine reading your text out to someone who is directly affected by what you are writing about or involve those people in writing or reviewing the text.

To complement this approach, there are some techniques that can help to make you understand your reader better. One of the most important is

the use of people-centric language – referring to people first and foremost. Examples include "people affected by severe asthma", "children living with interstitial lung disease", and people who took part in the study' rather than "patients", "asthma sufferers" and "subjects".

There is also a fine line between writing accessibly and patronising the audience. To avoid the latter, make things clear but do not repeat yourself unnecessarily. For example, acronyms can be used where appropriate, as long as they are expanded in brackets the first time they are used.

Finally, it is good practice to be mindful of how your text will affect readers. It may be that a disease that you describe affects some of your readers. In this case, consider how you can make the overall tone more positive, perhaps by talking about survival rather than mortality or explaining what can be done in the future to improve the situation for people with the disease in question. Try to avoid terms such as "suffering".

There is also the question of risk perception. In order to hook readers, journalists often use sensationalist or absolute language in their headlines and stories. Scientists and professionals are well positioned to counter sensationalism and safeguard against unnecessary anxiety by using more balanced language. This could be as simple as using qualifiers where a research finding is not well established (*e.g.* "people with sleep apnoea could be at higher risk of atherosclerosis") or ensuring that findings are well contextualised and compared with the existing body of research where appropriate; for example, the risks of air pollution exposure being compared to smoking a cigarette.

Conclusion

By practising writing clearly, conscientiously and in an engaging manner for a general audience, researchers and clinicians can open up the world of science and medicine, and empower people to become involved and interested in these topics. In an age where information is more available and not always reliable, skills in communicating accessibly can help academics and professionals to direct the narrative around health and disease for the benefit of patients and the general public.

Although we have focussed in this article on communicating with the public, it should be stated that many of the points that make writing for a lay audience successful can also be advantageous in academia. In fact, many journals are now demanding a clear, concise and active style. Therefore, taking on board the tips in this article could improve your writing for many more scenarios.

Affiliations

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Conflict of interest

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