

## Clinical Information Quality Framework for Digital Health Technologies

### Introduction

Q1 Digital health technologies (DHTs), such as electronic health records, clinical decision support systems and electronic prescribing systems, are widely used in patient care. Researchers at Imperial College London have developed an instrument for assessing the quality of clinical information from DHTs based on evidence from literature. This could help to prevent injuries and deaths associated with poor quality clinical information from DHTs. This study aims to obtain your inputs as a healthcare professional using information from DHTs. Kindly read further information about the study in the [participant information sheet](#).

### Consent

Q2 If you are happy to proceed with this study, please complete the consent form below:

- I confirm that I have read and understood the participant information sheet, version 1.4 dated 3 November 2020, and have had the opportunity to ask questions which have been answered fully. (1)
- I give consent for information collected about me to be used to support other research in the future, including those outside of the European Economic Area (EEA). (8)
- I give consent to being contacted about the potential to take part in other research studies. (9)
- I understand that my participation is voluntary, and I am free to withdraw at any time, without giving any reason and without my legal rights being affected. (10)
- I give permission for Imperial College London to access my research records that are relevant to this research. (11)
- I consent to take part in the above study. (12)

**Participant Information**

Q3 Please select which best describes your clinical role.

- Doctor (1)
- Nurse/Nurse Practitioner/Advanced Care Practitioner (2)
- Pharmacist/ Clinical Pharmacist (3)
- Physiotherapist/Occupational Therapist (4)
- Physician Associate (5)
- Others (e.g. Community Health Worker, Healthcare Surveillance Officer) (6)

*Display This Question:*

*If Please select which best describes your clinical role. = Others (e.g. Community Health Worker, Healthcare Surveillance Officer)*

Q4 If others, please specify

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Q5 In which country do you currently reside?

▼ Afghanistan (1) ... Zimbabwe (1357)

Q6 Gender

- Male (1)
- Female (2)
- Prefer not to say (3)

Q7 Please state how long you have used digital health technologies such as electronic health record, electronic prescribing system, telemedicine and clinical decision support system in clinical practice?

▼ 1 year (4) ... 10 years and above (13)

Q8. How relevant to quality and safety of care do you consider each of these attributes of clinical information from DHTs?

	Strongly relevant	Somewhat relevant	Neither relevant nor irrelevant	Somewhat irrelevant	Strongly irrelevant
Accuracy: the extent to which information is free from errors.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Completeness: the extent to which no needed information is missing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interpretability: the extent to which information can be understood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plausibility: the extent to which information makes sense in the light of existing knowledge.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provenance: the extent to which the source of information is trustworthy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Relevance: The extent to which information is useful for the intended task.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Accessibility: the extent to which information is easily obtainable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Portability: the extent to which information is available in different systems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Security: the extent to which information is protected from unauthorized access.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Timeliness: the extent to which up-to-date information is available when needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conformance: the extent to which information is presented in the desired format.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consistency: the extent to which information is presented in the same format.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintainability: the extent to which information can be easily maintained (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Clinical Information Quality Assessment (Accuracy)**

Q9. Would you include, exclude or modify the following question when assessing quality of clinical information from DHTs?

**Accuracy:** Is the information from the digital health technology free of errors?

**Very Accurate.** The information from the digital health is completely free of errors.

**Accurate:** The information from the digital health technology is free of errors that could lead to adverse events.

**Inaccurate:** The information from the digital health technology contains few errors that could lead to adverse events.

**Very inaccurate:** The information from the digital health technology contains several errors that could lead to adverse events.

NB: Adverse event is an unintended physical injury resulting from or contributed to by medical care that requires additional monitoring, treatment or hospitalisation or that results in death.

Include as it is

Exclude

Modify

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**Display This Question:**

*If Would you include, exclude or modify the following question when assessing quality of clinical in... = Modify*

Q10 Please state any modification you would like to suggest regarding definition and assessment of accuracy?

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### Clinical Information Quality Assessment (Completeness)

Q11. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Completeness:** Is no needed information missing from the digital health technology?

**Very complete:** No information is missing from the digital health technology.

**Complete:** No information required for clinical decision (diagnosis, treatment or prognosis) is missing from the digital health technology.

**Incomplete:** Few information required for clinical decision (diagnosis, treatment or prognosis) are missing from the digital health technology.

**Very incomplete:** Several information required for clinical decision (diagnosis, treatment or prognosis) are missing from the digital health technology.

Include as it is (1)

Exclude (4)

Modify (5)

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*Display This Question:*

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... =  
Modify*

Q12 Please state any modification you would like to suggest regarding definition and assessment of completeness.

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**Clinical Information Quality Assessment (Interpretability)**

Q13. Would you include, exclude or modify the following question when assessing quality of clinical information from DHTs?

**Interpretability:** Could the information from the digital health technology be understood to make clinical decision?

**Very interpretable:** Additional resources provided to aid interpretation of the information from the digital health technology (e.g. arrows or colour coding to indicate abnormal results, indications of medication)

**Interpretable:** Standard resources provided to aid interpretation of the information from the digital health technology (e.g. reference range)

**Uninterpretable:** Information from the digital health technology cannot be interpreted without seeking clarification from its author.

**Very uninterpretable:** Completely meaningless information not suitable for clinical decision.

Include as it is

Exclude

Modify

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**Display This Question:**

*If Would you include, exclude or modify the following question when assessing quality of clinical in... = Modify*

Q14 Please state any modification you would like to suggest regarding definition and assessment of interpretability.

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**Clinical Information Quality Assessment (Plausibility)**

Q15. Would you include, exclude or modify the following question when assessing quality of clinical information from DHTs?

**Plausibility:** Does the information from the digital health technology make sense based on common knowledge?

**Very plausible.** The information from the digital health technology agrees with common knowledge (e.g. raised inflammatory markers in a patient with sepsis).

**Plausible.** The information from the digital health technology agrees with common knowledge if exceptional circumstances are considered (e.g. normal inflammatory markers in a patient with sepsis due to delayed immune response)

**Implausible:** The information from the digital health technology disagrees with common knowledge (e.g. Arterial blood gasses with oxygen saturation of 60% when pulse oximeter records 94%)

**Very implausible:** The information from the digital health technology makes no sense at all based on common knowledge (e.g. physiological parameters incompatible with life).

Include as it is

Exclude

Modify

**Display This Question:**

*If Would you include, exclude or modify the following question when assessing quality of clinical in... = Modify*

Q16 Please state any modification you would like to suggest regarding definition and assessment of plausibility.

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**Clinical Information Quality Assessment (Provenance)**

Q17. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Provenance:** Is the source of the information in the digital health technology trustworthy?

**Very trustworthy:** The information in the digital health technology is from highly trustworthy source (e.g. UN Agencies, Official Government Agencies, Academic institutions, Hospitals).

**Trustworthy:** The information in the digital health technology is from recognised private corporations (e.g. non-governmental organisations, registered charities).

**Untrustworthy:** The information in the digital health technology is from sources with obvious conflict of interest (e.g. pharmaceutical companies, tobacco companies).

**Very untrustworthy:** Unverifiable source of information and unsubstantiated claims (e.g. broadcast information on social media, no references), unsuitable for clinical decision

Include as it is

Exclude

Modify

**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q18 Please state any modification you would like to suggest regarding definition and assessment of provenance.

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**Clinical Information Quality Assessment (Relevance)**

Q19. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Relevance:** Is the information from the digital health technology useful for the intended task?

**Very relevant:** All information from the digital health technology is useful for the intended task

**Relevant:** Most of the information from the digital health technology is useful for the intended task?

**Irrelevant:** Most of the information from the digital health technology not useful for the intended task

**Very irrelevant:** None of the information from the digital health technology is useful for the intended task

Include as it is

Exclude

Modify

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**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q20. Please state any modification you would like to suggest regarding definition and assessment of relevance.

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**Clinical Information Quality Assessment (Accessibility)**

Q21. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Accessibility:** Is the information easily obtainable from the digital health technology?

**Very accessible:** The information from the digital health technology is obtainable with no difficulties at the point of care.

**Accessible:** The information from the digital health technology is obtainable with minor difficulties that could be resolved at the point of care (e.g through a phone call to IT Department)

**Inaccessible:** The information from the digital health technology is not obtainable at the point of care.

**Very inaccessible:** The information from the digital health technology is not obtainable at all.

Include as it is

Exclude

Modify

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*Display This Question:*

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q22. Please state any modification you would like to suggest regarding definition and assessment of accessibility.

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**Clinical Information Quality Assessment (Portability)**

Q23. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Portability:** Is the information from the digital health technology accessible in different systems?

**Very portable:** The information from the digital health technology is accessible at all levels of healthcare system (primary, secondary & tertiary).

**Portable:** The information from the digital health technology is accessible at all levels of healthcare with minor difficulties that could be resolved at the point of care (e.g. transferable on request).

**Unportable:** The information from the digital health technology is only accessible at the level of care where it was created.

**Very unportable:** The information from the digital health technology is only accessible on the computer system where it was created.

Include as it is

Exclude

Modify

**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q24 Please state any modification you would like to suggest regarding definition and assessment of portability.

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### Clinical Information Quality Assessment (Security)

Q25 Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Security:** Is the information in the digital health technology protected from unauthorised access?

- Very secure:** The information in the digital health technology is securely protected against unauthorized access using multiple strategies (e.g. password and swipe card).
- Secure:** The information in the digital health technology is securely protected against unauthorised access using a single strategy (e.g. requires only password).
- Insecure:** The information in the digital health technology is accessible to multiple healthcare professionals without a need for authorisation (e.g. information obtainable from the hospital without a need for personal log-in)
- Very insecure:** The information is publicly accessible (e.g. information on hospital website)

- Include as it is
- Exclude
- Modify

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*Display This Question:*

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q26 Please state any modification you would like to suggest regarding definition and assessment of security.

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**Clinical Information Quality Assessment (Timeliness)**

Q27 Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Timeliness:** Is up-to-date information from the digital health technology available when it is needed?

**Very timely:** Up-to-date information is available from the digital health technology at the point of care with no delays.

**Timely:** Up-to-date information is available from the digital health technology at the point of care with minor delays which do not affect the use of the information for clinical decision (e.g. slow log-in)

**Untimely:** Up-to-date information is unavailable from the digital health technology at the point of care due to major delays which affect the use of the information for clinical decision (e.g. system is down for a couple of hours)

**Very untimely:** The information from the digital health technology is outdated and/or not available when needed for clinical decision

Include as it is

Exclude

Modify

**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q28 Please state any modification you would like to suggest regarding definition and assessment of timeliness.

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**Clinical Information Quality Assessment (Conformance)**

Q29. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Conformance:** Is the information from the digital health technology presented in the desired format?

- Very conformant:** All the information from the digital health technology conforms to international or local standards (e.g. SI units).
- Conformant:** Most of the information from the digital health technology conforms to international or local standards.
- Non-conformant:** Most of the information from the digital health technology do not conform to local or international standards.
- Very conformant:** All the information from the digital health technology do not conform to local or international standards making it unsafe for clinical decision (e.g. medication doses presented without units).

Include as it is

Exclude

Modify

**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q30. Please state any modification you would like to suggest regarding definition and assessment of conformance.

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**Clinical Information Quality Assessment (Consistency)**

Q31. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Consistency:** Is the information presented in the same format within the digital health technology?

- Very consistent:** All the information is presented consistently in the same format (e.g. consistently expressing Hb as g/dL) within the digital health technology.
- Consistent:** Most of the information is presented consistently in the same format within the digital health technology.
- Inconsistent:** Most of the information is not presented in the same format within the digital health technology.
- Very inconsistent:** Multiple formats of information which is potentially confusing and unsafe for clinical decision.

- Include as it is
- Exclude
- Modify

**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... = Modify*

Q32 Please state any modification you would like to suggest regarding definition and assessment of consistency.

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**Clinical Information Quality Assessment (Maintainability)**

Q33. Would you include, exclude, or modify the following question when assessing quality of clinical information from DHTs?

**Maintainability:** Could the information within the digital health technology be easily maintained?

**Very maintainable:** The information within the digital health technology could be maintained without difficulties.

**Maintainable:** The information within the digital health technology could be maintained with minor difficulties resolvable at the point of care.

**Unmaintainable:** The information within the digital health technology could not be easily maintained.

**Very maintainable:** The information within the digital health technology could not be maintained at all.

NB: Maintainance includes activities such as storing, auditing, updating date.

Include as it is

Exclude

Modify

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**Display This Question:**

*If Would you include, exclude, or modify the following question when assessing quality of clinical i... =  
Modify*

Q34 Please state any modification you would like to suggest regarding definition and assessment of maintainability.

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### Q35. CLIQ Framework for Digital Health Technology

<b>Informativeness</b> directly concerns the usefulness of digital information for clinical purposes	Accuracy	the extent to which information is correct
	Completeness	the extent to which no required information is missing
	Interpretability	the extent to which information can be understood
	Plausibility	the extent to which information makes sense based on common knowledge
	Provenance	the extent to which the source of information is trustworthy
	Relevance	the extent to which information is useful for the intended task
<b>Availability</b> concerns the functionality of the system holding clinical information	Accessibility	the extent to which existing information is easily obtainable
	Portability	the extent to which information is accessible in different systems
	Security	the extent to which information is protected from unauthorized access and corruption
	Timeliness	the extent to which current information is available on time
<b>Usability</b> concerns the ease of use of clinical information	Conformance	the extent to which information is presented in the desired format
	Consistency	the extent to which information is presented in the same format
	Maintainability	the extent to which information can be maintained

Q36. Would you like to retain or modify the above categories?

- Retain the categories
- Modify the categories

*Display This Question:*

*If Would you like to retain or modify the above categories? = Modify the categories*

Q37 Please state how you would want the categories to be modified.

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Q38 Thank you for taking part in this eDelphi survey. Please provide your email so we can share the summary of the findings with you and contact you for the subsequent round.

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