

Artificial intelligence driven clinical decision-support systems to assist healthcare professionals and people with diabetes at the point of care: a Delphi-based roadmap

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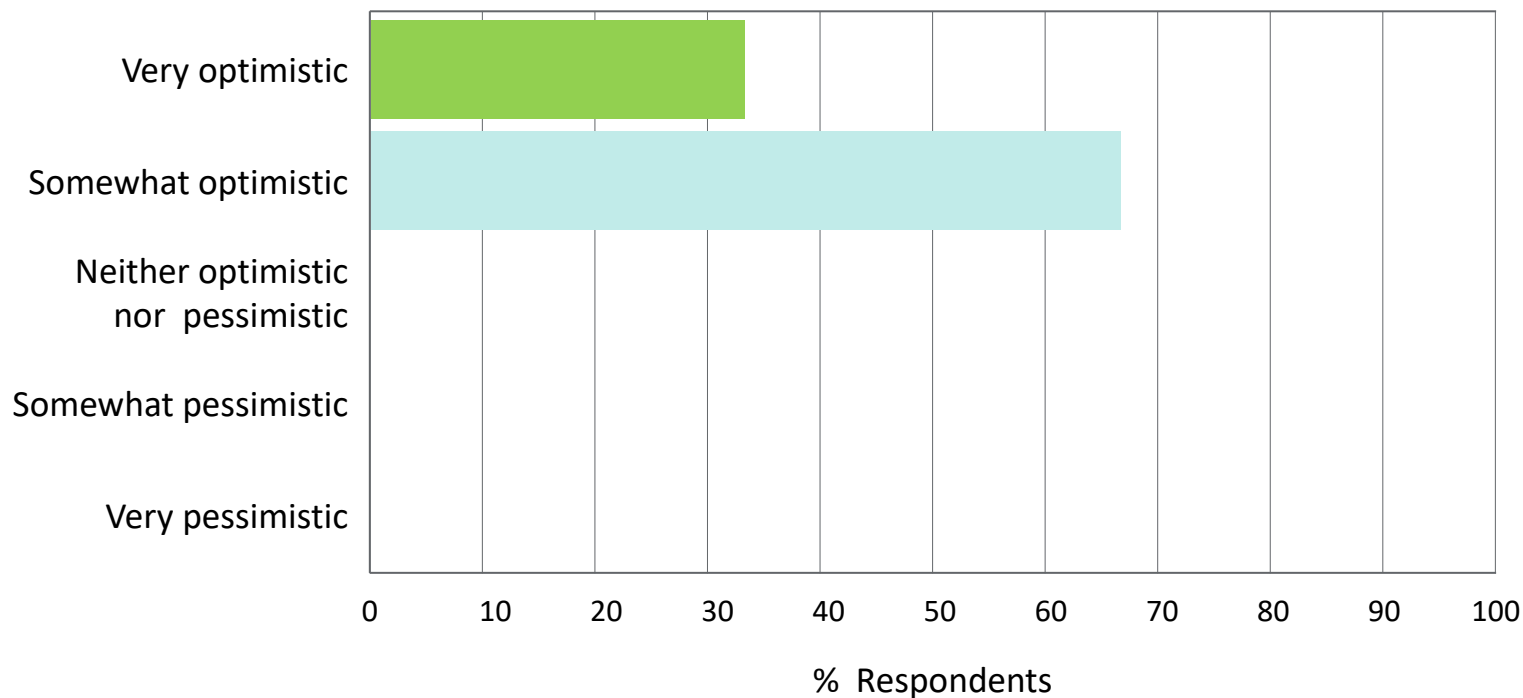
See main manuscript for affiliations of EU working group members

AI-based clinical decision support systems in diabetes care

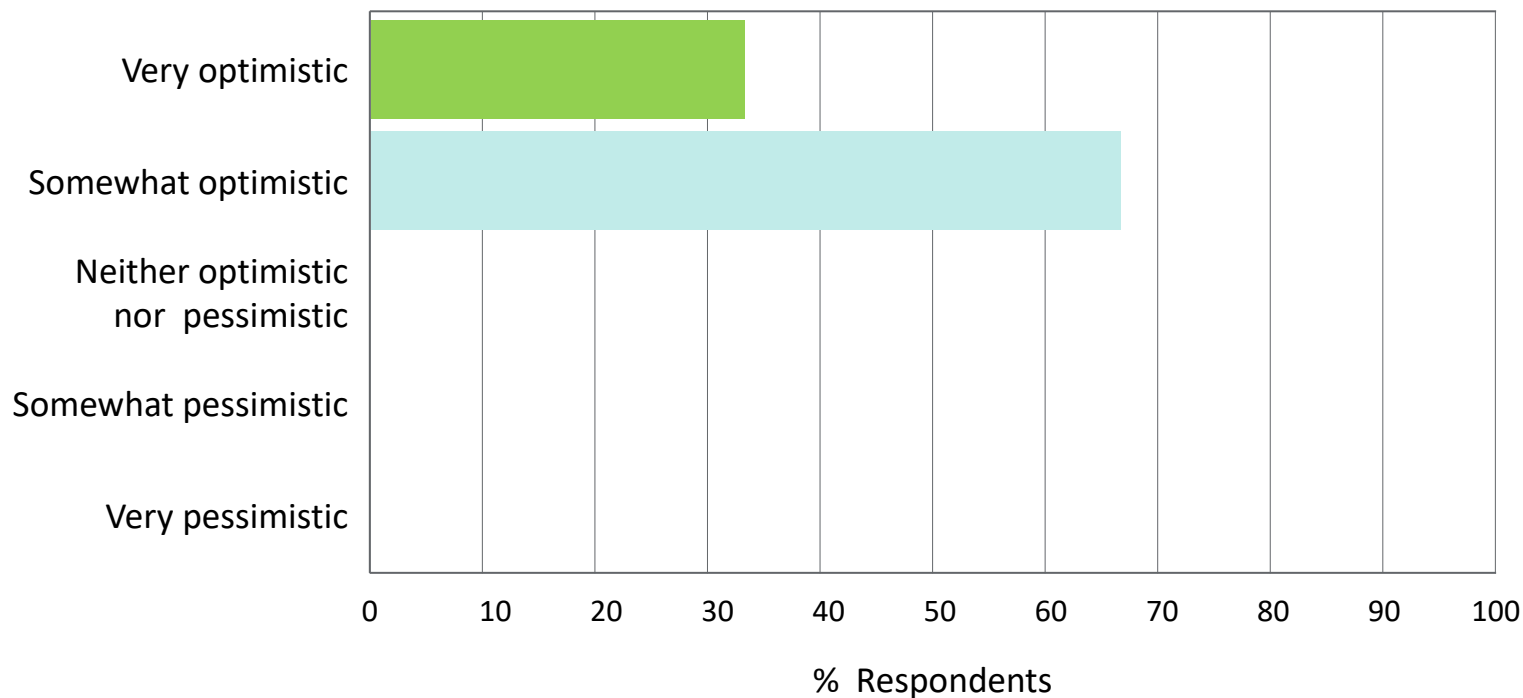
Delphi Survey Outcomes



How optimistic/pessimistic you are that AI-driven diabetes CDSS will improve clinical outcomes for **people with diabetes** in the next 5-10 years?



How optimistic/pessimistic you are that AI-driven diabetes CDSS will improve clinical outcomes for **healthcare professionals** in the next 5-10 years?



How do you rate the potential benefits of AI-driven diabetes CDSS over the next 5-10 years*?

	Not at all important			Very important	
Ranked outcomes [‡]	1	2	3	4	5
1. Improved treatment outcomes for people with diabetes			11.1%	77.8%	11.1%
2. The delivery of personalized medicine for people with diabetes			22.2%	33.3%	44.4%
3. Improved diagnosis of diabetes and diabetes-related complications			22.2%	44.4%	33.3%
4. Improved quality of life for people with diabetes			44.4%	44.4%	11.1%
5. Reduced costs of diabetes care		22.2%	22.2%	44.4%	11.1%

* Based on respondents' own experience and opinion

‡ Ranking based on total score ≥4, then next highest individual scores

Comments regarding the potential benefits of AI-driven diabetes CDSS over the next 5-10 years*?

1. Improved diagnosis and quality of life require improvements in many different components and might be more complex for the use of AI
2. Will reduce the costs of diabetes overall for the society, but might increase some of the care associated costs. The use of AI driven CDSS can enable a more personalized approach to treatment for patients with diabetes, addressing areas such as medication optimization, disease progression, and complication prevention. As such tools are utilized and support clinician decision making, they have the potential to impact long term costs associated with treatment and complications
3. Big data analysis and AI will open new way to manage Chronic diseases as Diabetes. Here the challenges are how these aspects are driven respecting data regulations, how public and industrial sector unite efforts in a win - win perspective and under a principal of effectiveness, better QoL and efficiency. It is also from now a strong priority that recipients of these solutions also must be aligned, understanding what are the problem that will be addressed and with the appropriate and clear commitment to adopt and implement that advances
4. Should be used for routine labour-intensive activities such as eye screening or in semi-automating insulin delivery in type 1 diabetes

Indicate your level of concern regarding the challenges associated with the implementation of AI-driven diabetes CDSS over the next 5-10 years *?

	Not at all concerned				Very concerned
Ranked outcomes [‡]	1	2	3	4	5
1. Regulatory processes in assessment of CDSS				55.6%	44.4%
2. The need for agreed data standards			11.1%	33.3%	55.6%
3. Change in clinical workflows and integration in delivery of diabetes care			22.2%	33.3%	44.4%
4. Data information and privacy			22.2%	22.2%	55.6%
5. Data quality			22.2%	55.6%	22.2%
6. Managing costs associated with implementing CDSS			33.3%	33.3%	33.3%
7. Primary care capacity/skills to accept a greater role in managing diabetes care		22.2%	11.1%	44.4%	22.2%
8. Human factors in application of CDSS			44.4%	44.4%	11.1%
9. Education & training in application of CDSS		22.2%	33.3%	22.2%	22.2%
10. Clinical guidelines in application of CDSS	11.1%		55.6%	33.3%	

* Based on respondents own experience and opinion

‡ Ranking based on total score ≥ 4 , then next highest individual scores

Comments regarding the challenges associated with AI-driven diabetes CDSS over the next 5-10 years*?

1. Implementation of AI unfortunately strongly depends on the healthcare budget and the availability of experienced experts for AI implementation
2. Some of the largest IT companies and even consultancy companies now focusing on monetizing AI. We have to make sure that as we build tools for CDSS that they are compliant for use on the regulatory side, as well as ensuring a benefit not only to healthcare professionals, patients, and healthcare systems. CDSS tools must meet data privacy, security, and quality standards
3. Ensuring clinicians of all disciplines remain focussed on the patient rather than the technology

Indicate the level of importance you would assign to the areas of application for AI-driven diabetes CDSS over the next 5-10 years*?

	Not at all important			Very important	
Ranked outcomes [‡]	1	2	3	4	5
=1. Diabetes treatment optimization (e.g., intensification or deintensification)				55.6%	44.4%
=1. Medication decision support (e.g., drug selection and dosing)				55.6%	44.4%
3. Screening & diagnosis of diabetes complications (micro- or macrovascular)			11.1%	33.3%	55.6%
4. Predicting short-term adverse events (e.g., DKA, severe hypoglycemia, coma)			11.1%	55.6%	33.3%
5. Diabetes treatment response (i.e., change in measures of glycemic control, weight, etc.)			11.1%	77.8%	11.1%
6. Risk assessment for diabetes complications			22.2%	55.6%	22.2%
7. Diabetes disease profiling (i.e., disease progression and severity)			22.2%	66.7%	11.1%
8. Population predictive risk management (e.g., predict obesity, resource management, etc.)			33.3%	44.4%	22.2%
9. Dietary and lifestyle management (e.g., weight loss, improve physical activity, etc.)			33.3%	55.6%	11.1%

* Based on respondents own experience and opinion

‡ Ranking based on total score ≥ 4 , then next highest individual scores

Comments regarding the areas of application for AI-driven diabetes CDSS over the next 5-10 years

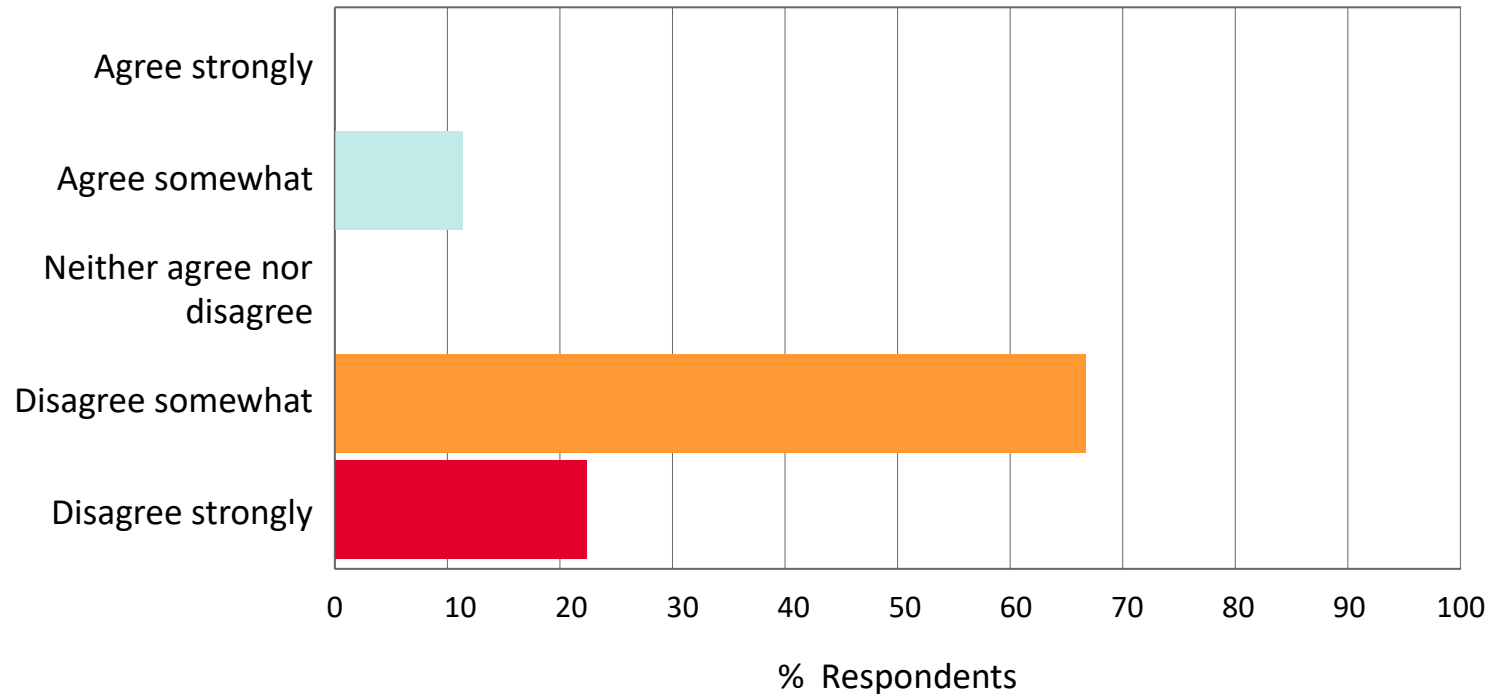
1. Dietary and lifestyle management depends on many societal factors and thus might be difficult to incorporate them into the system
2. Comments regarding the factors that will impact the implementation of AI-driven diabetes CDSS
3. The order of importance might vary from country to country, but costs should not be neglected

Rank the factors that will most impact the implementation of AI-CDSS over the next 5-10 years*

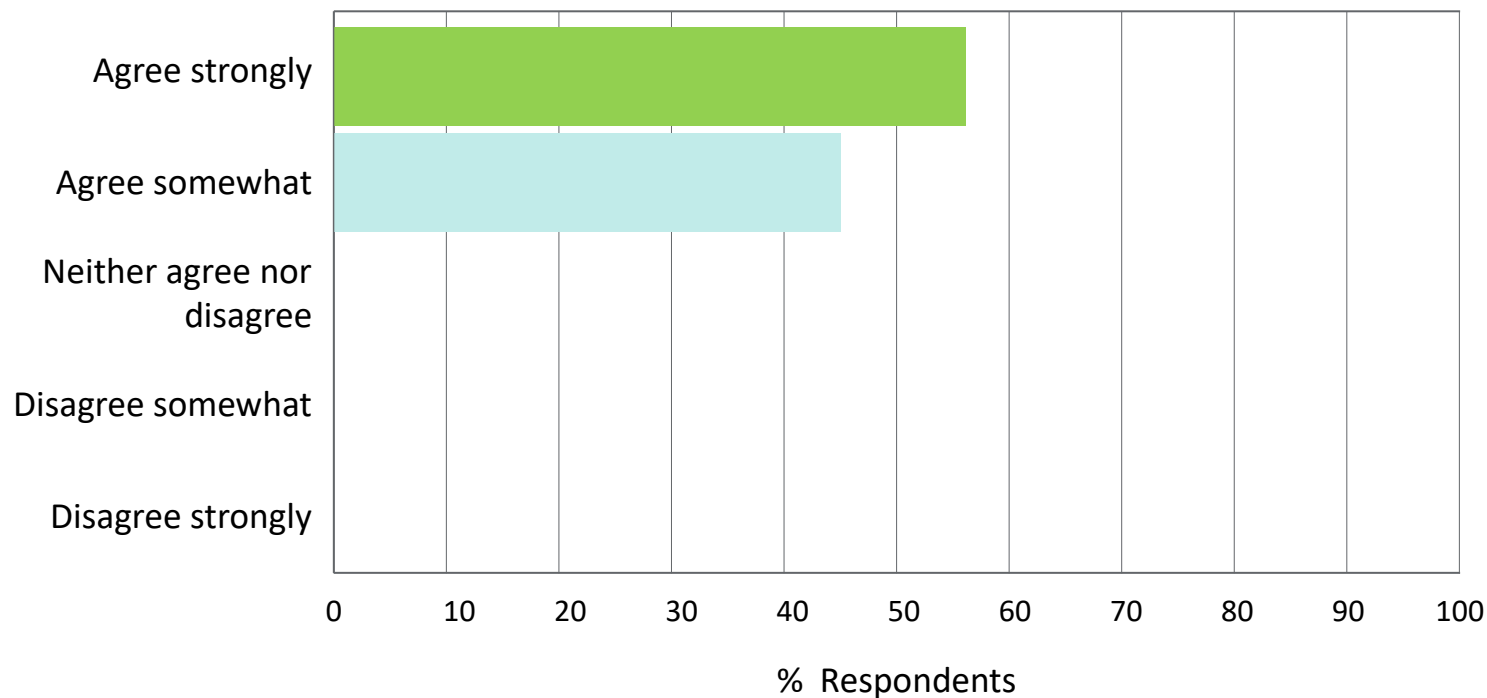
	Least important			Most important			
Ranked outcomes	1	2	3	4	5	6	7
1. Data quality				22.2%	11.1%	44.4%	22.2%
2. Compliant electronic medical record (EMR) formats				11.1%	44.4%	22.2%	22.2%
3. Patient privacy		33.3%	11.1%	11.1%	11.1%	22.2%	11.1%
4. Cost	44.4%		11.1%	11.1%	11.1%	11.1%	11.1%
5. Service design	11.1%	33.3%	22.2%	11.1%			22.2%
6. Continuing professional development & training		33.3%	44.4%	11.1%			11.1%
7. Undergraduate medical education	44.4%		11.1%	22.2%	22.2%		

* Based on respondents own experience and opinion

I am concerned that AI-driven diabetes CDSS will replace good clinical judgement in diabetes care



I believe that AI-driven diabetes CDSS will enhance clinical productivity in diabetes care



Summary points of note

- Respondents were universally optimistic that AI-driven diabetes CDSS will improve clinical outcomes both for people living with diabetes and for HCPs tasked with their diabetes care.
- The **highest-rated potential benefit** of AI-driven CDSS in the 10-year horizon was improved diabetes treatment outcomes.
- The **lowest-ranked potential benefit** was reduced costs for diabetes care.
- Amongst the challenges associated with implementing AI-driven diabetes CDSS, the regulatory process for CDSS assessment and approval was of most concern, along with the need for agreed data standards.
- **Education & training** in application of CDSS and the need for CDSS-specific clinical guidelines were the challenges of least concern.
- Application of AI-driven CDSS in diabetes is perceived to be most important for **diabetes treatment optimization and for medication decision support**.
- The lowest-ranked (out of 9) area of application was **dietary and lifestyle management**.
- Critical factors that will most impact implementation of AI-driven CDSS are data quality and the need for compliant electronic medical-record (EMR) formats.
- Least important critical success factors are CPD for HCPs and undergraduate medical education.