

Supplement Table 1 Semi-structured interview guide

Items in both pre- and post-intervention interviews

Confidence in conducting fundoscopic procedures
Teaching fundoscopic procedures to junior physicians
Past reasons for performing fundoscopic exams
Significance of fundoscopic exams
Past reasons fundoscopic exams were not performed
Disadvantages of not performing fundoscopic exams
How to increase the implementation of fundoscopic exams

Items only in pre-intervention interviews

Participants' background (hospital at which participant completed
medical internship, rotation assignment, workplace)
Education and training related to fundoscopic exams
Past experiences and current experience with fundoscopic exams

Items only in post-intervention interviews

Successful experiences over 2 months (findings, contribution to medical care)
Unsuccessful experiences over 2 months (cases, improvement plans)

Supplement Table 2 Breakdown of factors in indication cases for fundoscopic exams during initial outpatient consultations

	All cases (n = 595)		p-value
	Phase 1 (n = 284)	Phase 2 (n = 311)	
Count (n) and ratio (%) of factors in indication cases			
High blood pressure	94 (33.1)	81 (26.1)	0.059
Diabetes	32 (11.3)	24 (7.7)	0.14
Complaining of ocular symptoms	20 (7.0)	7 (2.3)	0.005
Complaining of headache	34 (12.0)	41 (13.2)	0.66
Total	151 (53.2)	162 (52.1)	0.79

Supplement Table 3 Reasons for not performing the fundoscopic examination

Survey item	Phase 1, n (%)	Phase 2, n (%)	p-value
It was not needed to make a diagnosis	13 (87)	13 (87)	1
It was not needed to evaluate chronic diseases	5 (33)	2 (13)	0.39
I didn't know it was medically useful	3 (20)	2 (13)	1
I thought it would be a cost burden to patients	4 (27)	2 (13)	0.65
I thought it would be a cost burden to Japan's national healthcare spending	2 (13)	2 (13)	1
I'm not confident in how to use the fundoscope	12 (80)	1 (7)	<0.001
Even though I always use the fundoscope, I can't conduct medical exams well with it	9 (60)	3 (20)	0.06
It's too time-intensive	7 (47)	5 (33)	1
It's not sanitary	2 (13)	0 (0)	0.48
I forgot	11 (73)	11 (73)	1
The patient didn't want it	0 (0)	0 (0)	1
It was not convenient for the development of patient rapport	2 (13)	5 (33)	0.39
There was an abnormality in the refractive media of the eye (optical system) such as a cataract	2 (13)	2 (13)	1
There were problems with the irises, such as miosis	0 (0)	1 (7)	1
The room was too bright	0 (0)	0 (0)	1
The fundoscope was broken	0 (0)	0 (0)	1
The PanOptic™ direct ophthalmoscope was not available	5 (33)	1 (7)	0.17
Other	Phase 1	Phase 2	
(please specify)	There were few scenarios in which the exam was considered necessary for diagnosis. Ophthalmic visits were the primary mode of evaluating chronic diseases.	Already followed up by an ophthalmologist. Already diagnosed as an eye disease and already in treatment with an ophthalmologist.	

Supplement Table 4 Qualitative research results

Category	Concept	Description	Code No.	Variation
[Positive motivation: exam characteristics]	<Simple, inexpensive, minimally invasive>	The characteristics of fundoscopic exams include simplicity (rapidness), low price (low-cost), and minimal invasiveness.	6	"Can easily identify changes in blood vessels." "Rather than turn the patient to the ophthalmology department, the diagnosis could be done quickly by evaluating the exam from nearby." "I'm sure there are things I could observe with a fundoscope without conducting an invasive examination; maybe if I improve my skills, there will be things I could identify without exposing the patient to radiation."
	<Essential for primary care>	Recognizing the significance of fundoscopic exams in providing primary care	7	"I think there are significant benefits to patients in primary care, or outpatients." "If you go to the countryside, there are a lot of people who leave diabetes untreated. In that sense, maybe this exam is unnecessary."
	<Significance in evaluating complications from chronic diseases>	Acknowledging the exam's significance to the staging of chronic diseases such as diabetes and hypertension	26	"(I verify) whether there are no changes in the fundus in (patients who have) DM (abbreviation for Diabetes Mellitus) with high HbA1c or consistently high blood glucose, and maybe high blood pressure (patients). I verify at an early stage whether there's something to worry about, as I think it's related to QOL. I try to estimate their medical history and how long the disease has been untreated." "Sometimes we'd get patients with extremely high blood pressure or severe diabetes unrelated to their chief complaint. For those types of patients, we did the exam just in case."
	<Significance in evaluating retinal diseases>	Acknowledging the exam's significance in obtaining findings for retinal diseases such as uveitis	23	"(I conducted the exam) on patients with an ophthalmological complaint, who claim a disorder in the field of view or loss of vision." "Facial symptoms, eye symptoms. If I'm able to assist with the first consultation, I might be able to find the cause when the patient complains of ocular abnormalities."
	<Significance in evaluating increased brain pressure>	Acknowledging the exam's significance in obtaining findings for increased brain pressure	15	"For example, I perform the exam hoping to see a congestive optic disc, but I never have." "I think most times I conducted the exam because of symptoms like headaches or to rule out intracranial disease."
	<Self-directed learning opportunity>	Acknowledging the exam as a chance for self-directed learning and practicing on patients for learning or practice opportunities	20	"I don't have the confidence yet to use the fundoscope in a procedure, so maybe this isn't ideal, but I've been performing the exam in the sense of practice." "Even if I can't see, I'd like to perform the exam as it could be practice."
	<Desire to learn procedures>	Desire for an opportunity to receive lectures and guidance on fundoscope and to acquire skills	21	"I wish I'd have the opportunity to learn" "If it were me, I'd probably use the fundoscope if I learned more about evaluation methods."
	<Environmental pressures>	Pressure and suggestions from work colleagues and bosses to perform the fundoscopic examination. Implementing the exam based on a sense of duty or to conform to surroundings	25	"It was pressure. Pressure to show [the checklist] to senior physicians" "There were many items that I didn't forget because of the existence of the checklist, or rather, that I was glad to remember because the attending physician reminded me. I think most often, the act of showing the checklist made me realize things I missed, and made me think to do them."
	<Educational initiative>	Being proactive in teaching fundoscopic exams to junior physicians and interns	16	"It's a necessary skill, so of course I feel I need to teach it, but first I'd like to improve my own fundoscopic skills" "I gained the skill so I thought about teaching it. In reality, I only taught it once or twice, but this made me want to teach it."
	[Positive motivation: physician factors]	<Inferior to ophthalmology >	Thinking that one's consultations and examinations are inferior to those performed by an ophthalmologist	34
<Inferior to alternative exams>		Thinking the procedure falls short of alternatives to fundoscopic exams	5	"(I don't do the exam) because I immediately think of taking a CT. If you think about it, technically you should be able to see the abnormality using a fundoscope. But (other exams seem faster and more accurate); I'm sure this isn't limited to the fundoscope, but patients might question why we examine the eye if we're going to take a CT anyway." "I'll send a real eye disease case to the ophthalmology department. And, well, I'll use a urine test for microvascular damages caused by chronic conditions. But I wonder if a (fundoscopic) evaluation needs to be done as much as they say; maybe the evaluation could be done (by an alternative exam)."
[Negative motivation: exam characteristics]				

[Negative motivation: physician factors]	<Distrust from patients and resistance to cost>	Doctors feel reluctant and patients feel distrust regarding the addition of costs to elevate individual procedures	24	"If you have confidence in yourself and confidence in your findings, you can charge money." "I think there will be patients who will be suspicious if indications are not explained to them."
	<False positive/negative findings>	To falsely identify abnormal findings as normal findings (and vice versa), which could lead to delays in diagnosis and re-examination and cause de-merits with respect to the patient's physical, psychological, and financial aspects.	8	"There are many complex overlapping diseases, so I worry about missing a diagnosis if I fail to perform a (fundoscopic exam) on people with ocular symptoms, for example those suspected of connective tissue disease (CTD)." "It's a difficult decision, but if there's a chance of missing something even if with the exam (I'd rather send the patient to ophthalmology department)." "Where I have the least confidence is if I haven't missed an abnormality."
	<Time performance>	Benefits to the patient and self per unit of time	27	"It's a lot of time spent on the procedure. If there is something to gain, I'll do it, but I rarely get the time." "To be honest, if you ask me whether I'd proactively want to examine the eye myself when I'm already busy at work, I feel it's low priority. I'd like to do the exam when I'm more confident in the procedure."
	<Avoidance due to physical proximity to patients>	Resistance to getting close to patients while using a fundoscope based on their characteristics	25	"The exhalation gets sparse. I hold my breath a little and use care." "It might be hard to do the exam if the patient was someone young or a young woman." "It's the sense of distance. I think the exam would be difficult to do on a young man."
	<Lack of understanding of significance>	Not understanding the significance of fundoscopic exams	35	"I don't yet have enough understanding of it, but (I will do it) if I can understand the significance in doing the fundoscopic exam"
	<Lack of knowledge>	Lack of knowledge about fundoscopic exams	6	"To date, I haven't really had any problems so (I didn't do it). I think I'll do it if I sense the need." "I didn't know the disease causes changes to the fundus." "I have to review my knowledge on the findings themselves. If I look back on my studies, I'd know what findings emerge with high blood pressure. But if it's an unfamiliar procedure, I might miss review areas if I do it quickly."
	<Inexperience in procedure>	Lack of proficiency in procedures related to fundoscopic exams	20	"I could only see part of the fundus in the first place, and I wasn't sure there were abnormalities. I wasn't confident in my procedure." "It's unreasonable to blame the device, but I wonder if there is something that makes it easier to see. (I think) procedurally it's quite difficult."
	<Lack of confidence>	Lack of confidence in implementing fundoscopic exams	44	"Actually, I don't have much (confidence). I feel it's difficult to see through the fundoscope, and I don't have too much confidence in determining findings to have absolutely no abnormalities." "Even if I think there are no abnormalities, I really don't have any confidence in my judgement if it's not seen (by another doctor)." "I'm not confident enough in my skill to use my findings as the basis for diagnoses."
	<Oversight>	Simply forgot to implement the fundoscopic exam	22	"Also, there are some occasions when I forget to do the exam even if the patient has a history of high blood pressure." "Mainly the reason for not performing the exam is that I'd forgotten."
	[Non-implementation]	<Lack of educational initiative>	Lack of initiative to teach the fundoscopic exam to juniors and attending physicians	15
<Opportunity cost of patient benefits>		Opportunity loss when exam is not performed on a patient whose fundus has never been evaluated	10	"If the patient has a chronic disease and is showing complications, (by not testing) we would have lost an opportunity to diagnose, especially if the patient's fundus hadn't been checked before. [We should check] even if the concern is completely separate from the primary complaint." "[Without the exam], we might miss something that could have served as a clue for diagnosis, like Roth spots. The likelihood is low, but..."
<Abandonment due to incomplete achievement>		Incomplete achievement of objectives or giving up and cancelling the exam part-way	12	"If we pick up on something, the patient might be motivated to visit an ophthalmologist." "It would have taken a lot of time if I seriously wanted to do the exam to the end. I often stopped after viewing a little and thinking, 'I won't see it.'" "I saw it once, but didn't see it well, so I stopped. There's issues with the procedure."
[Unsuccessful implementation]	<Lack of successful experiences in detecting abnormalities>	Lack of successful experiences in the past, i.e. experiences confirming a true positive for abnormal findings.	39	"I don't have many successful experiences. Even if I could see, I'm not confident in the interpretation. I'm not confident that I could determine the findings to be normal." "During my shallow experience, I haven't encountered abnormal findings that would change the way I consult." "I can't evaluate much by myself, and I haven't been able to find any abnormalities so far, so I assume there won't be a big difference if I do the exam."

[Successful implementation]

<Progress of skills>	Increased implementation of fundoscopic exams have the effect of shortening the time required	19	"I was able to clearly see the fundus partway through the exam, so there were fewer barriers to doing the (exam)." "The procedure itself became smoother as my skills improved in seeing the fundus. It takes a shorter time to obtain findings now. I can obtain them accurately and in a short amount of time."
<Successful experiences and confidence building>	Successful experiences gained by performing the fundoscopic exam and developing confidence as a result	35	"I think it's really important to keep trying the exam. The physicians' threshold (to do the exam) is likely to be lowered if they can gain a sense of achievement or confidence from knowing they tried and were able to execute the exam." "I think I gained confidence because I was able to see the fundus. In particular, seeing the blood vessels and optic disc led to confidence." "Compared to the beginning, my confidence has increased a little since I've done the procedure more often."
<Granting a sense of security and satisfaction>	Giving patients a sense of security and satisfaction through the fundoscopic exam	3	"I think the patients gained a sense of security that they were being seen."
<Recording and sharing>	Recording and sharing findings in the fundus with others for educational use and assurance of objective validity for findings and judgments	30	"If we could leave photographic records, we might find objective evidence." "If we could all share findings together, I'd feel more confident." "The hardest part is not knowing if the attending physician's findings match what I'm seeing. Similar to a video laryngoscope, something that could transmit what I'm seeing would lower the threshold (to conducting the exam)." "I think it's important to keep records if there is a function to save records. Sharing the records with others for educational purposes would be good for myself as an instructor."
<Advantages of PanOptic™>	Advantages using the PanOptic™ over the direct ophthalmoscope	27	"I don't have any psychological resistance due to the wide field of view and less proximity to the patient." "I feel comfortable because of the distance; I don't have to worry about damaging the eyes or bumping it by accident."
<Usefulness of the checklist>	A sense that the fundoscope checklist was useful or specific examples	25	"(the checklist) reminds me when I forget. Even when I don't feel like doing the fundoscopic exam, the checklist makes me think, 'The patient has a chronic disease after all, maybe I should do it' as a little added effort anyway." "I thought it was useful. I've experienced forgetting the exam, so I think the checklist helped eliminate oversights." "It was extremely useful. It increased opportunities to do the exam, which led to training and skill improvement."
<On-hand reference for abnormal findings>	Prepare ahead of time by placing a figure with normal/abnormal fundus findings in the proximity of the fundoscope exam for quick reference.	29	"I don't keep (a photo for reference), and am not able to look at one quickly. The result would be to receive feedback against what I see (exam findings). Since I will receive (feedback), it will ultimately lead to more confidence and possible implementation (of more fundoscopic exams)."

[Improvement plan]

No. _____

Checklist for Fundoscopic Exam

Did you perform a fundoscopic exam on your patient?

I did

I submitted instructions for taking costs

Why did you do it?

- To evaluate for complications chronic diseases (such as HTN and DM)
- To evaluate for fundus changes in systemic disease
- To make diagnose the primary retinal disease
- To evaluate of increased intracranial pressure
- Other ()

I did NOT

Why did NOT you do it?

- Not a patient indicated for the fundoscopic exam
- Not useful for differential diagnosis
- Cost and social factors
- Patient-related factors (ex. lack of consent)
- Other ()

You need to receive a signature while consulting the attending physician.
Attending physician are asked to assist in checking the form to prevent omissions

Attending physician had confirmed the above

You submit the checklist at the end of the consultation to a designated box.

Contact : Daiki Yokokawa