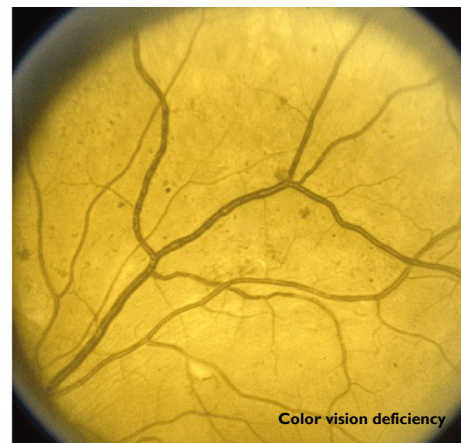


Normal color vision



Color vision deficiency

Image reproduced from Spalding et al., Clin Experimental Optometry, Volume: 93, Issue: 1, Pages: 39-41, First published: 07 January 2010, DOI: (10.1111/j.1444-0938.2009.00434.x).
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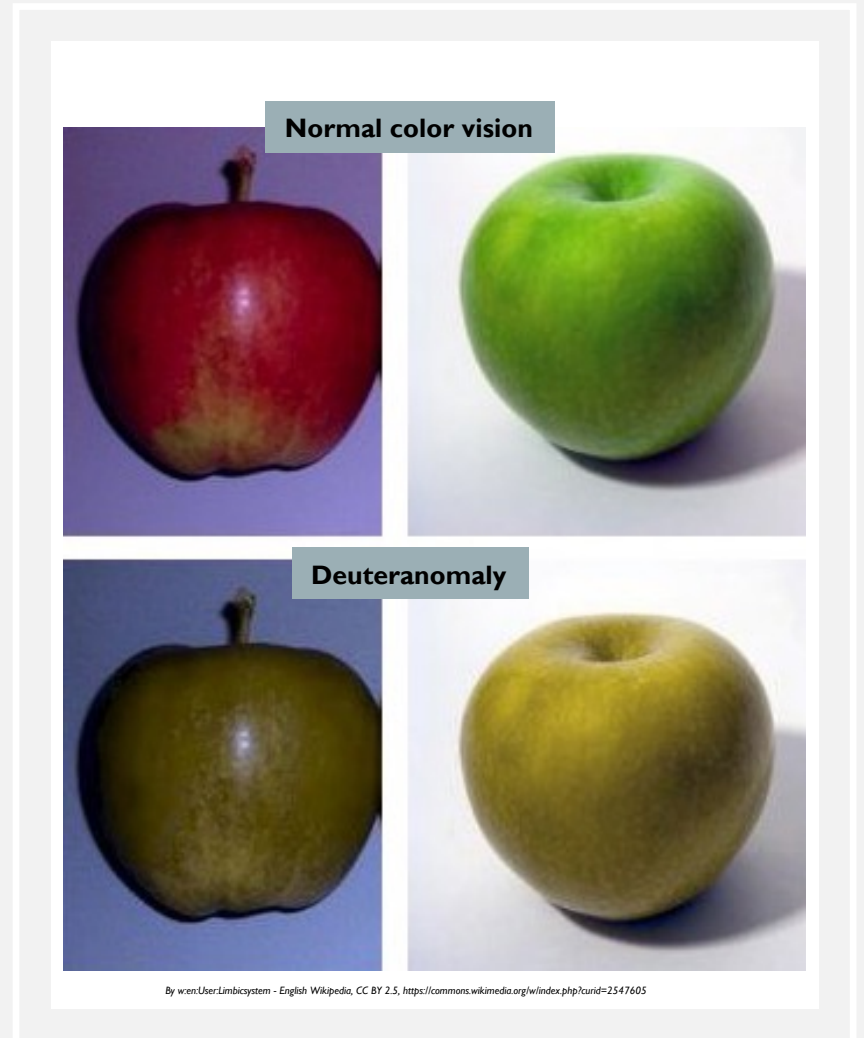
COLOR VISION DEFICIENCY: IS IT A SIGNIFICANT HANDICAP FOR MEDICAL STUDENTS AND PHYSICIANS?

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BACKGROUND

- **Normal color vision:** three types of cone photoreceptors; blue (short wave-sensitive), green (middle wave-sensitive) and red (long wave-sensitive) cones.
- **Color vision deficiency (CVD):** abnormality or absence of one or more photosensitive cone pigments
 - Anomalous trichromacy: reduced sensitivity to red (**protanomaly**), green (**deuteranomaly; the most common**) and blue (**tritanomaly**)
 - Dichromacy: complete absence of a cone pigment [1]
- **Congenital CVD:** usually X-linked recessive mode of inheritance; **8% ♂** and **0.5% ♀** with CVD in general population; deuteranomaly is the most common form [2]
- In medical practice observation of color is often crucial for diagnosis and management; however, **prevocational screening for CVD is not standard practice in medicine** [3].



PURPOSE

- To investigate:
 - The **frequency** of CVD in the medical community
 - The **practical implications** of CVD diagnosis for a medical student and/or clinician
 - The **advice** that should be given to an individual with CVD contemplating a career in medicine

METHODS


- **Systematic review of literature** using PubMed database
- Search terms: “color vision deficiency”, “color vision impairment”, “medicine”, “medical students”, “doctors”, “clinicians”, “health care”, “medical community”, “color blindness”
- Inclusion criteria: English language articles, experimental studies, observational studies, systematic review, narrative review; Exclusion criteria: non-human studies
- 20 studies included after eligibility assessment by two independent reviewers (M.E., A.C.)

RESULTS

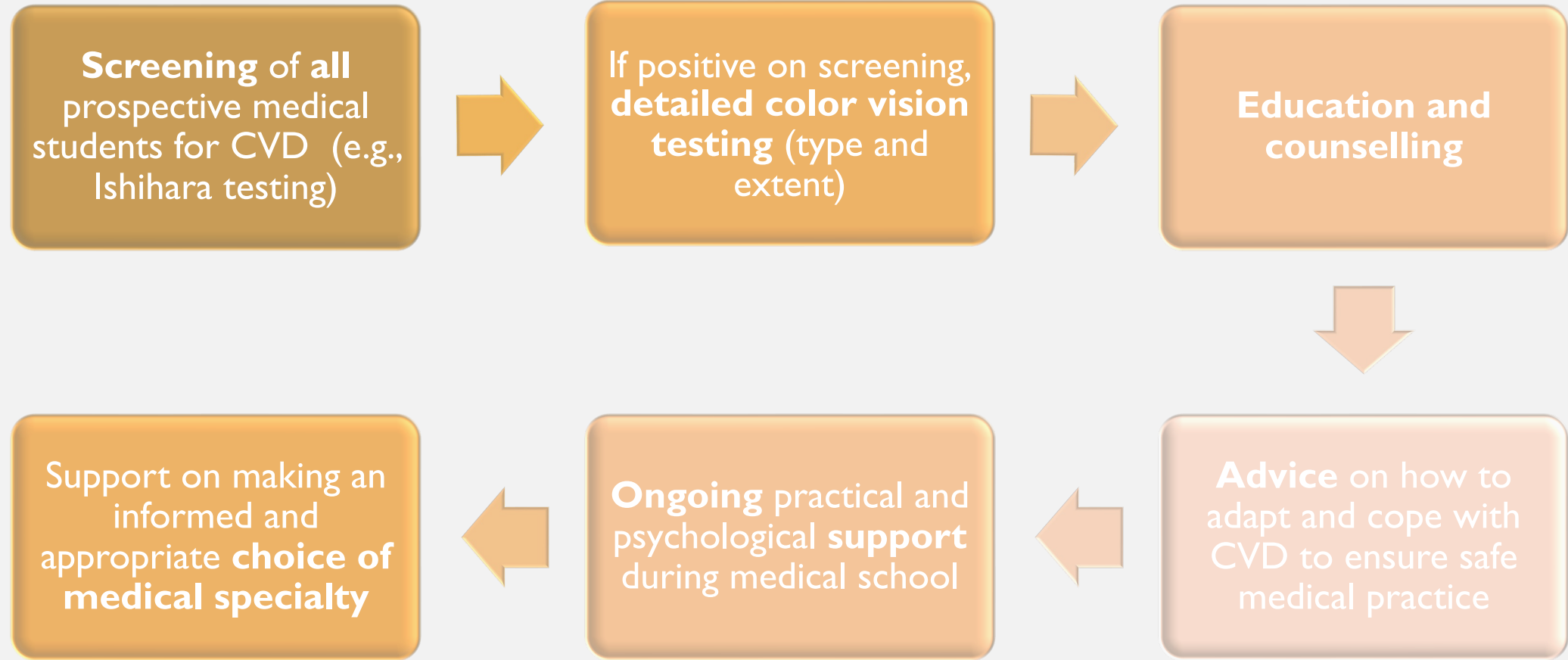
- The **prevalence of CVD in the medical profession** is similar to that of the general population (8% ♂ and 0.5%) [3-5].
- People with CVD **often lack awareness** of the severity and impact of their deficiency
- CVD is **not a criterion for rejection to study or practice medicine** in most countries including the United States and United Kingdom [5-7].
 - *Historically, Japan had the most restrictive policy with 55.8% of medical schools excluding individuals with CVD in 1986 → dropped to lower than 2% with efforts by the Japanese Ophthalmologists Association in 1992 and the ophthalmologist Yasuyo Takayanagi*
- **Prospective medical students are not screened for CVD** in the majority of medical schools around the world
 - *Exceptions: 1 university in the UK (Queen's University of Belfast) and a few more in the rest of the world including medical schools in Taiwan, Indonesia and Malaysia [5-7].*
- Most medical students with CVD, although they admit facing several difficulties in detecting colors in various settings during medical training, did not feel that the defect was significant and that they should not practice medicine [6-13].
- Medical practitioners with CVD have reported that they sometimes made errors due to CVD; but due to limited evidence, we cannot estimate how often these errors occur and how serious they are [14-21].

Medical specialties where color vision deficiency matters more

General practice
Ophthalmology
Ear, nose and throat
Paediatrics
Gastroenterology
Pathology
Microbiology
Surgery

Difficulties identified by <u>medical students</u> and <u>physicians</u> with color vision deficiency	Coping strategies	
Microscopy: histology, hematology, microbiology	<ul style="list-style-type: none"> • Focus on cell/tissue structure and staining density rather than color variation • Grayscale adjustment • Digitally enhance images 	
<p>Clinical examination:</p> <ul style="list-style-type: none"> • Body color changes: pallor, cyanosis, jaundice, cherry red • Local skin findings: erythema, rash • Oral cavity lesions • Bloor or bile in urine, sputum, stools, vomitus • Slit lamp exam findings (e.g., erythema, hemorrhage, pigment, hyphaema) 	<ul style="list-style-type: none"> • Close observation • Proper environment for physical examination (e.g., good illumination) • Cross-checking • Consulting colleagues • Detailed history taking • Appropriate choice of medical specialty 	<ul style="list-style-type: none"> ❖ <i>Novel technologies/therapies:</i> <ul style="list-style-type: none"> • Color filter over glasses [22]  • Contact lenses [23] • Gene therapy (attempted in mice, adult monkeys and patients with achromatopsia [24-26])
Fundoscopy (e.g., optic disc pallor, diabetic changes, hemorrhage, pigment)		
Otoscopy (e.g., inflammation, wax, blood)		
Teaching methods (e.g., blackboards, projectors)		
Color coding (e.g., diagrams, charts, pills, slides, test strips for blood and urine, ultrasound doppler technology)		

PROPOSED ALGORITHM FOR PROSPECTIVE MEDICAL STUDENTS



CONCLUSIONS

1. CVD poses a challenge to medical students and professionals; however, there is no evidence to support that it is a significant handicap for clinicians.
2. A balance should be kept between the rights of an individual with CVD to pursue a career in medicine and the concerns about patient safety.
3. We propose early screening of all prospective medical students and full color vision testing for those who screen positive; this would allow individuals with CVD to acknowledge their condition and its severity and develop coping strategies.
4. Further dedicated studies should be designed to determine the competency of medical professionals with CVD in realistic clinical settings.

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