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# Frequency of Eye Diseases in Residents of Nursing Homes – 1-Year Results of a Novel Telemedicine Service in Switzerland

## Häufigkeit von Augenerkrankungen bei Pflegeheimbewohnern – 1-Jahres-Ergebnisse eines neuartigen telemedizinischen Dienstes in der Schweiz

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### ABSTRACT

**Purpose** For the elderly in nursing homes, a visit to the ophthalmologist is a burden, which might lead to undertreatment. We have recently started offering a novel ophthalmological service combining onsite examination and telemedical interpretation for patients with limited access to ophthalmological care. This study summarises the frequency of findings of treatable eye diseases after the first year of operation in

participants who dropped out from regular ophthalmological control.

**Methods** Participants' clinical characteristics, frequency of service utilisation, and findings were extracted from the system and analysed.

**Results** Of 1946 residents approached, 540 (27.7%; 1080 eyes) signed up for the service. A complete examination was possible in 412 persons (813 eyes) and partially possible in the remaining 128. The mean age of the examined participants mean age was 83.9 years (SD 9.7), and they were predominantly female (69.8%). The majority had a diagnosis of dementia (54.5%) and 20.2% had diabetes mellitus requiring treatment. The median care level (ranging from 0–12) was 7 (interquartile range 6–9), corresponding to a care need of 121–140 min/d. The mean best-corrected decimal visual acuity was 0.55 (SD 0.24). For 164 eyes (15.2%), the current spectacle correction was insufficient. An untreated cataract was present in 145 eyes (13.4%), 89 eyes (8.2%) were receiving glaucoma treatment, and 7 eyes had a decompensated glaucoma. Dry age-related macular degeneration (AMD) appeared in 276 eyes (25.6%), 12 eyes (1.1%) had wet AMD, and 24 eyes (11.0%) among patients with diabetes showed signs of diabetic retinopathy. Other pathologies were uncommon.

**Conclusion** Residents of nursing homes, who are unable to attend regular ophthalmological control, show various treatable ophthalmological conditions, including cataracts, glaucoma, and retinal pathologies. Screening with a novel telemedicine service allows for the identification of treatable conditions and careful planning and referral of patients to appropriate clinics having the necessary infrastructure for this particular population.

### ZUSAMMENFASSUNG

**Zweck** Für ältere Menschen in Pflegeheimen ist ein Besuch beim Augenarzt eine Belastung, die zu einer Unterversorgung führen kann. Seit Kurzem bieten wir einen neuartigen augen-

ärztlichen Dienst für Patienten mit eingeschränktem Zugang zur augenärztlichen Versorgung an, der eine Vor-Ort-Untersuchung mit telemedizinischer Interpretation kombiniert. Diese Studie fasst die Häufigkeit von behandelbaren Augenkrankheiten nach dem 1. Betriebsjahr bei Personen zusammen, die sich nicht mehr in regelmäßiger ophthalmologischer Betreuung befanden.

**Methoden** Die klinischen Merkmale der Teilnehmer, die Häufigkeit der Inanspruchnahme des Angebotes und die Befunde wurden aus dem System extrahiert und analysiert.

**Ergebnisse** Von 1946 kontaktierten Bewohnern meldeten sich 540 (27,7%; 1080 Augen) für die Untersuchung an. Bei 412 Personen (813 Augen) war eine vollständige Untersuchung möglich, bei den übrigen 128 eine teilweise. Das Durchschnittsalter der untersuchten Teilnehmer betrug 83,9 Jahre (SD 9,7) und sie waren überwiegend weiblich (69,8%). Bei der Mehrheit war eine Demenz bekannt (54,5%) und 20,2% hatten einen behandlungsbedürftigen Diabetes mellitus. Die mittlere Pflegestufe (0–12) betrug 7 (Interquartilsbereich 6–9), was einem Pflegebedarf von 121–140 min/d

entsprach. Der mittlere bestkorrigierte Dezimalvisus betrug 0,55 (SD 0,24). Bei 164 Augen (15,2%) war die aktuelle Brillenkorrektur unzureichend. Bei 145 Augen (13,4%) lag eine unbehandelte Katarakt vor, 89 Augen (8,2%) befanden sich in Glaukombehandlung und 7 Augen hatten ein dekompensiertes Glaukom. 276 Augen (25,6%) hatten eine trockene AMD, 12 Augen (1,1%) eine feuchte AMD und 24 Augen (11,0%) der Patienten mit Diabetes wiesen Anzeichen einer diabetischen Retinopathie auf. Andere Krankheitsbilder waren selten.

**Schlussfolgerung** Bei Bewohnern von Pflegeheimen, die nicht in der Lage sind, an regelmäßigen augenärztlichen Kontrollen teilzunehmen, treten verschiedene behandelbare Augenkrankheiten auf, darunter Katarakt, Glaukom und Netzhauterkrankungen. Screening mit einem neuartigen telemedizinischen Dienst ermöglicht die Identifizierung behandelbarer Erkrankungen und eine sorgfältige Planung und Überweisung der Patienten an geeignete Kliniken, die über die notwendige Infrastruktur für diese besondere Bevölkerungsgruppe verfügen.

## Introduction

According to the latest statistics, the number of patients with age-related macular degeneration (AMD) will rise from around 200 to 290 million worldwide by 2040 [1], and the number of patients with diabetes from around 400 to 650 million [2]. This socio-demographic shift is leading to a bottleneck in ophthalmological checks for chronic diseases in old age (diabetes, glaucoma, AMD) and also poses the risk of undersupply in Switzerland, resulting in an increase in avoidable visual deterioration and blindness. Several studies have shown that the decrease in visual performance is associated with loss of independence, increase in morbidity injurious falls, and low quality of life [3–5].

Ophthalmic care of elderly persons with limited mobility is particularly demanding and stressful for the affected individuals. To fight undertreatment of this vulnerable patient group, we established a service, including a basic ophthalmological examination carried out by trained paramedical personnel at nursing homes. We assess visual acuity, eye pressure, and the outer eye with eyelid, conjunctiva, cornea, and iris, lens, and optic nerve as well as the retina. All examination findings are recorded electronically. The interpretation of findings is carried out remotely by board certified ophthalmologists using our telemedicine platform. Recommendations are recorded in a doctor's letter.

This study summarises the frequency of findings of treatable eye diseases after the first year of operation in participants who dropped out from regular ophthalmological control.

## Methods

The aim of this investigation was to evaluate the performance and efficiency of a service applying evidence-based clinical standards. Therefore, this study is not subject to the Human Research Act. Accordingly, no ethics committee had to approve this analysis.

## Description of Service

Residents and their relatives or guardians were informed in writing by the nursing homes about the service. Interested persons were asked to sign a consent form. A basic ophthalmological examination is offered, as it is usually performed in the ophthalmologist's office by trained technical staff. Visual acuity, pressure conditions of the eye, the outer eye with eyelid, conjunctiva, cornea, and iris as well as the retina are evaluated. All examination findings are recorded electronically. The interpretation, assessment, and suggested procedure is done by a senior ophthalmologist and recorded in a doctor's letter. If a junior ophthalmologist analysed the examination, a senior ophthalmologist reviewed the results before recording the doctor's letter. This letter is sent to the patient or a designated responsible person, the physician working at the nursing home, and/or the ophthalmologist. If necessary, arrangements will also be made for the fitting of eyeglasses or other visual aids. The service is fully covered by basic health insurance.

## Clinical Examination and evaluated diseases

Clinical information on additional diseases, such as the presence of a neurological disease or dementia, was extracted from the diagnostic lists of the institutions.

Refraction measurement is used to determine visual acuity. This consists of three measurements: a) uncorrected visual acuity, b) visual acuity with the existing (spectacle) correction, and c) the best possible correction. The eye pressure is measured with a pressure gauge to rule out an ophthalmic pressure disease (glaucoma). Both eyes are photographed with a special camera. The set of images includes the anterior segments of the eye, the central retina (with macula and optic nerve), and the peripheral retina. Using this examination setup, we are able to evaluate the eye for the most important eye illnesses such as the inflammation of the eyelids (blepharitis) or other structures of the eye. Also, we detect refractive anomalies, which can be corrected with glasses or the

presence of cataract, glaucoma, diabetic retinopathy, and macular degeneration. Since the examinations are carried out in close cooperation with the nursery homes' responsible general practitioner, it can be decided in each individual case – taking into account the general situation of the patient – which therapies are effectively useful or not. The risk of overtreatment is thus significantly reduced.

### Devices used for clinical examination

**Refraction:** The Nidek AR/ARK-1 works with a special diode and measures in a range of 6 mm. This large measurement zone results in a very precise measurement result. The diode also allows a qualitative assessment of the regularity of the cornea.

**Intraocular pressure:** The iCare Tonometer Pro device allows pressure measurements without anaesthesia. The pressure values are comparable to Goldmann applanation tonometry. The measuring method is more comfortable than the Air Puff tonometers available in optician stores. Due to disposable measuring heads, the measurement is hygienic and microbiologically safe. The tilt sensor also allows measurements to be taken with the patient lying down and in patients with dementia, where suboptimal conditions for measurement may exist.

**Examination of the anterior segment:** The Horus handheld Digital Fundus Camera offers a slit lamp attachment (MiiS Horus Scope), which can be used just like a conventional handheld slit lamp camera for taking images of the anterior eye including eyelids, cornea, anterior chamber, iris, and lens. It is freely movable to also examine patients not being able to move to a traditional slit lamp chin rest position.

**Fundus examination:** The Optomed Aurora is the first and so far only handheld fundus camera with a 50-degree field of view. It takes colour, red-free, and infrared images. Due to the autofocus and the handy weight, it is ideal for mobile use. For the quality of the photos to be good, the pupil must be enlarged with eye drops. Today's wide-angle cameras allowing fundus photography without dilating the pupil are not portable. To enlarge the pupil, one drop of tropicamide is applied to each eye as is done in an ophthalmologist's office. After 10 minutes, the pupil is sufficiently dilated for the fundus images to be taken.

### Statistical analysis

We summarised continuous variables with mean and standard deviation and dichotomous variables with percentages. In exploratory analyses, we assessed the relationship between possibility to complete the examination (yes/no) and presence of dementia (yes/no), the care level (7 or more/else), patients' age (continuous), and female gender (yes/no) using a multivariable logistic regression model. We also assessed interaction between the presence of dementia and a high care level by entering an interaction term to the model. Regression analysis was performed on the patient level. We considered a p value of less than five percent as statistically significant. Analyses were performed using the Stata 16.1 statistics software package (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX, USA: StataCorp LLC.)

## Results

Of 1946 residents approached, 540 (27.7%; 1080 eyes) signed up for the service. A complete examination was possible in 412 persons (813 eyes) and partially possible in the remaining 128. Examined participants mean age was 83.9 years (SD 9.7) and were predominantly female (69.8%). The majority had a diagnosis of dementia (54.5%) and 20.2% had diabetes mellitus requiring treatment. The median care level (ranging from 0–12) was 7 (interquartile range 6–9), corresponding to a care need of 121–140 min/d.

The mean best-corrected decimal visual acuity was 0.55 (SD 0.24). For 164 eyes (15.2%), the current spectacle correction was insufficient. An untreated cataract was present in 145 eyes (13.4%), 89 eyes (8.2%) were receiving glaucoma treatment, and 7 eyes had a decompensated glaucoma defined as an intraocular pressure > 30 mmHg. Dry AMD appeared in 276 eyes (25.6%), 12 eyes (1.1%) had wet AMD, and 24 eyes (11.0%) among patients with diabetes showed signs of diabetic retinopathy. Other pathologies were uncommon. Among wet AMD, all patients had a history of previous intravitreal anti-VEGF injections, which, however, in five eyes were already several months ago. Eyes with diabetic retinopathy were all untreated, non-proliferative, and mild to moderate based on clinical findings.

The exploratory analyses showed that presence of dementia per se was not associated with a lower likelihood to complete the examination [odds ratio (OR): 1.29 (95% CI: 0.86 to 1.93);  $p = 0.226$ ] as was patients' age [OR: 1.00 (95% CI: 0.98 to 1.02);  $p = 0.868$ ], and female gender [OR: 1.09 (95% CI: 0.71 to 1.69);  $p = 0.686$ ]. Only a higher care level [OR: 0.56 (95% CI: 0.33 to 0.94);  $p = 0.028$ ] was associated with a significantly lower chance of completing a full examination. We also found an interaction between the presence of dementia and a high care level [OR: 0.27 (95% CI: 0.09 to 0.88);  $p = 0.030$ ], indicating that dementia in the presence of a high care level was associated with a low likelihood to complete the full examination.

## Discussion

### Main findings

Residents of nursery homes, who are unable to attend regular ophthalmological control, show various treatable ophthalmologic conditions, including cataracts, glaucoma, and retinal pathologies. The majority of patients seen via this service had a case of dementia and required a median of more than 2 hours of care daily. While the presence of dementia alone was not associated with a lower probability of completing the examinations, a higher care level was. If dementia and high care level were jointly present, completing the full examination was least likely.

### Results in context of the existing literature

To the best of our knowledge, this is the first study of the incidence of eye disease in a group of nursing home residents who no longer attend regular eye examinations in Switzerland. We were able to show that this group of people has a significant number of treatable eye problems, which, if left untreated, can lead to

long-term visual deterioration. Inadequate spectacle correction was the most common finding, but retinal diseases, some of which were untreated, were also detected. In a 2016 study by Thederan and colleagues that examined the prevalence of ocular disease in German nursing homes, 22% of residents were found to have previously undiagnosed ophthalmologic diagnoses that required treatment, and 45% were recommended for regular ophthalmologic checkups [6]. Another 2019 study from Germany by Grau and colleagues used a telemedicine approach to examine the incidence of eye disease in the working population. Around 1000 working people were studied in a large Bavarian company. About 14% of those examined showed ocular findings that should be treated or controlled by an ophthalmologist [7].

Most of the mobile eye examinations took place before the SARS-CoV-2 pandemic because most of the nursing homes in Switzerland decided to temporarily close their institutions to visitors for protective reasons. Accordingly, we can rule out the possibility that the observed undertreatment in this group of persons was due to the SARS-CoV-2-related protective measures. Consequently, this study was also unable to determine the extent to which pandemic-related shortages of care in eye clinics resulted in further deterioration of care for these individuals. Several studies addressed changes in ophthalmic care for elderly patients during the SARS-CoV-2-induced lockdown. [8–14] A recently published multicentre study in Switzerland and five other countries of changes in care for patients with retinal disease showed that pandemic-related measures in eye clinics led to a reduction in treatment services and a deterioration in visual function [8]. Consequently, it must be assumed that the pandemic has led to additional undertreatment.

### Strength and limitations

The first investigation of the frequency of treatable eye diseases in residents of nursing homes in Switzerland is a strength of this study. The fact that the study was not conducted in the context of a scientific study in the strict sense, but that anonymised data from everyday operations were used to measure the quality of service, is a potential weakness of this study. Especially with regard to non-ophthalmological additional diseases, we had to rely on the information provided by the institutions. Especially regarding the presence of a neurological disorder or dementia, we did not perform independent investigations but used the diagnostic lists of the institutions. Likewise, we did not make any extraordinary efforts to motivate the residents for the tests. Accordingly, the results of measurements were sometimes missing. Although this probably worsened the data quality, they correspond to the realities of clinical routine.

### Implications for practice and research

Several studies provide evidence of some ophthalmic undertreatment in various age groups [15, 16]. Considering that many of the diseases are chronic and progressive, initiatives that aim to fill gaps in care are to be welcomed [17]. For the younger patient groups, it is important to emphasise the importance of basic ophthalmologic examinations from the age of fifty through information campaigns. For older groups, it is essential to periodically check whether an ophthalmologic examination is still being per-

formed. In our study, when questioned, it was found that the withdrawal from a regular checkup was gradual. Many of those examined in our setting stated that the last time they had seen an ophthalmologist was more than 5 years ago, even though diseases were already present at that time. If an ophthalmological checkup can only take place with difficulty for organisational reasons, the service described in this study offers an alternative. The examinations help to decide whether something must be done at all. In the group of patients, who needs treatment can be planned and pre-informed due to the examinations purposefully and under consideration of the existing restrictions.

From a scientific point of view, such examinations provide epidemiological data, which are hardly ever collected in the routine. In order to continuously improve the service, it is useful to better understand the barriers to accessing medical care. The study of patient journeys in geriatric ophthalmology would help to understand where support needs to be provided to help individuals maintain their sight and independence for as long as possible [16, 17].

### Conclusions

Screening with the new service allows for the identification of treatable conditions and careful planning and referral of patients to appropriate clinics having the necessary infrastructure for this particular population. Taking into account that we are facing a significant increase in the elderly population and – related to this – new care challenges for ophthalmology, it is necessary to promote technological innovations such as telemedicine, home care, and home monitoring [18–20]. By incorporating these care approaches, the pressure on existing care structures decreases and prevents ophthalmic underuse in those patient groups that have more difficult access to medical care due to their health conditions.

### Conflict of Interest

B. C. B. and L. M. B. are shareholders of Augenmobil AG. L. M. B. and K. R. L. are shareholders of medignition AG, an important shareholder of Augenmobil AG.

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