



## Summary Vision Screening Data: Switzerland

### Produced as part of Work Package 3

**Paolo Mazzone<sup>1</sup>, Dr Jill Carlton<sup>2</sup>, Dr Helen Griffiths<sup>3</sup>**

1. Research Assistant, School of Health and Related Research, University of Sheffield, United Kingdom (UK)
2. Senior Research Fellow, School of Health and Related Research, University of Sheffield, United Kingdom (UK)
3. Senior Lecturer, Academic Unit of Ophthalmology and Orthoptics, University of Sheffield, United Kingdom (UK)

*Information provided by Dr Veit Sturm, Head of the Department of Strabology and Neuro-Ophthalmology at the Eye Clinic of the Cantonal Hospital St. Gallen; Titular professor at the University of Zurich*

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## 1 Glossary of Terms: Vision Screening

<b>Abnormal test result</b>	A test result where a normal “pass” response could not be detected under good conditions. The result on screening equipment may indicate “no response,” “fail,” or “refer.”
<b>Attendance rate</b>	<p>The proportion of all those invited for screening that are tested and receive a result:</p> <ul style="list-style-type: none"> <li>• Invited for screening includes all those that are offered the screening test.</li> <li>• Tested and receive a result could be a “pass” or “referral to diagnostic assessment”.</li> </ul> <p>Attendance rate provides information on the willingness of families to participate in screening.</p>
<b>Compliance with referral (percentage)</b>	<p>The percentage of those who are referred from screening to a diagnostic assessment that actually attend the diagnostic assessment.</p> <p>Percentage of compliance provides information on the willingness of families to attend the diagnostic assessment after referral from screening.</p>
<b>Coverage</b>	<p>The proportion of those eligible for screening that are tested and receive a result:</p> <ul style="list-style-type: none"> <li>• Eligible for screening includes those within the population that are covered under the screening or health care programme.</li> <li>• Tested and receive a result could be a “pass” or “refer to diagnostic assessment”.</li> </ul> <p>Factors such as being offered screening, willingness to participate, missed screening, ability to complete the screen, and ability to document the screening results will influence the coverage.</p>
<b>False negatives</b>	<p>The percentage of children with a visual deficit (defined by the target condition) that receive a result of “pass” during screening.</p> <p>Example: If 100 children with visual deficit are screened, and 1 child passes the screening, the percentage of false negatives is 1%.</p>



<b>False positives</b>	The percentage of children with normal vision that are referred from screening to a diagnostic assessment.
<b>Guidelines</b>	Recommendations or instructions provided by an authoritative body on the practice of screening in the country or region.
<b>Vision screening professional</b>	A person qualified to perform vision screening, according to the practice in the country or region.
<b>Inconclusive test result</b>	A test result where a normal “pass” response could not be detected due to poor test conditions or poor cooperation of the child.
<b>Invited for screening</b>	Infants/children and their families who are offered screening.
<b>Outcome of vision screening</b>	An indication of the effectiveness or performance of screening, such as a measurement of coverage rate, referral rate, number of children detected, etc.
<b>Untreated amblyopia</b>	Those children who have not received treatment for amblyopia due to missed screening or missed follow-up appointment.
<b>Persistent amblyopia</b>	Amblyopia that is missed by screening, or present after the child has received treatment.
<b>Positive predictive value</b>	<p>The percentage of children referred from screening who have a confirmed vision loss.</p> <p>For example, if 100 babies are referred from screening for diagnostic assessment and 10 have normal vision and 90 have a confirmed visual defect, the positive predictive value would be 90%.</p>
<b>Prevalence</b>	The percentage or number of individuals with a specific disease or condition. Prevalence can either be expressed as a percentage or as a number out of 1000 individuals within the same demographic.
<b>Programme</b>	An organised system for screening, which could be based nationally, regionally or locally.
<b>Protocol</b>	Documented procedure or sequence for screening, which could include which tests are performed, when tests are performed, procedures for passing and referring, and so forth.
<b>Quality assurance</b>	A method for checking and ensuring that screening is functioning adequately and meeting set goals and benchmarks.
<b>Referral criteria</b>	A pre-determined cut-off boundary for when a child should be re-tested or seen for a diagnostic assessment.
<b>Risk babies / Babies at-risk</b>	All infants that are considered to be at-risk or have risk-factors for vision defects/ophthalmic pathology according to the screening programme.



	Two common risk factors are admission to the neonatal-intensive care unit (NICU) or born prematurely. However, other risk factors for visual defects may also be indicated in the screening programme.
<b>Sensitivity</b>	<p>The percentage of children with visual defects that are identified via the screening programme.</p> <p>For example, if 100 babies with visual defects are tested, and 98 of these babies are referred for diagnostic assessment and 2 pass the screening, the sensitivity is 98%.</p>
<b>Specificity</b>	<p>The percentage of children with normal vision that pass the screening.</p> <p>For example, if 100 babies with normal vision are tested, and 10 of these babies are referred for diagnostic assessment and 90 pass the screening, the specificity is 90%.</p>
<b>Target condition</b>	The visual defect you are aiming to detect via the screening programme.
<b>Well, healthy babies</b>	Infants who are <i>not</i> admitted into the NICU or born prematurely (born after a gestation period of less than 37 weeks).



## **2 Abbreviations**

<b>ACT</b>	Alternating Cover Test
<b>AR</b>	Autorefraction
<b>AS</b>	Automated Screening
<b>CT</b>	Cover Test
<b>CV</b>	Colour Vision
<b>EI</b>	Eye Inspection
<b>EM</b>	Eye Motility
<b>Fix</b>	Fixation
<b>GDP</b>	Gross Domestic Product
<b>GP</b>	General Practitioner
<b>Hir</b>	Hirschberg
<b>NICU</b>	Neonatal-intensive care unit
<b>PM</b>	Pursuit Movements
<b>PPP</b>	Purchasing Power Parity
<b>PR</b>	Pupillary Reflexes
<b>RE</b>	Retinal Examination
<b>ROP</b>	Retinopathy of Prematurity
<b>RR</b>	Red Reflex Testing
<b>SV</b>	Stereopsis
<b>VA</b>	Visual Acuity
<b>WHO</b>	World Health Organisation



### **3 Population and Healthcare Overview**

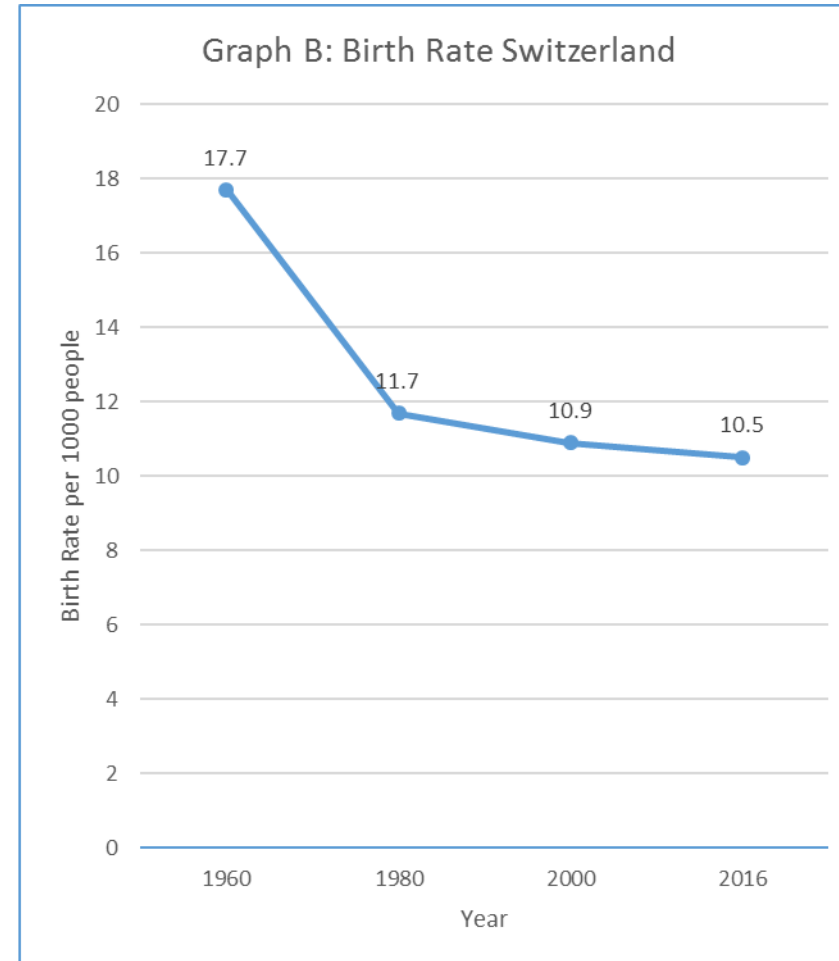
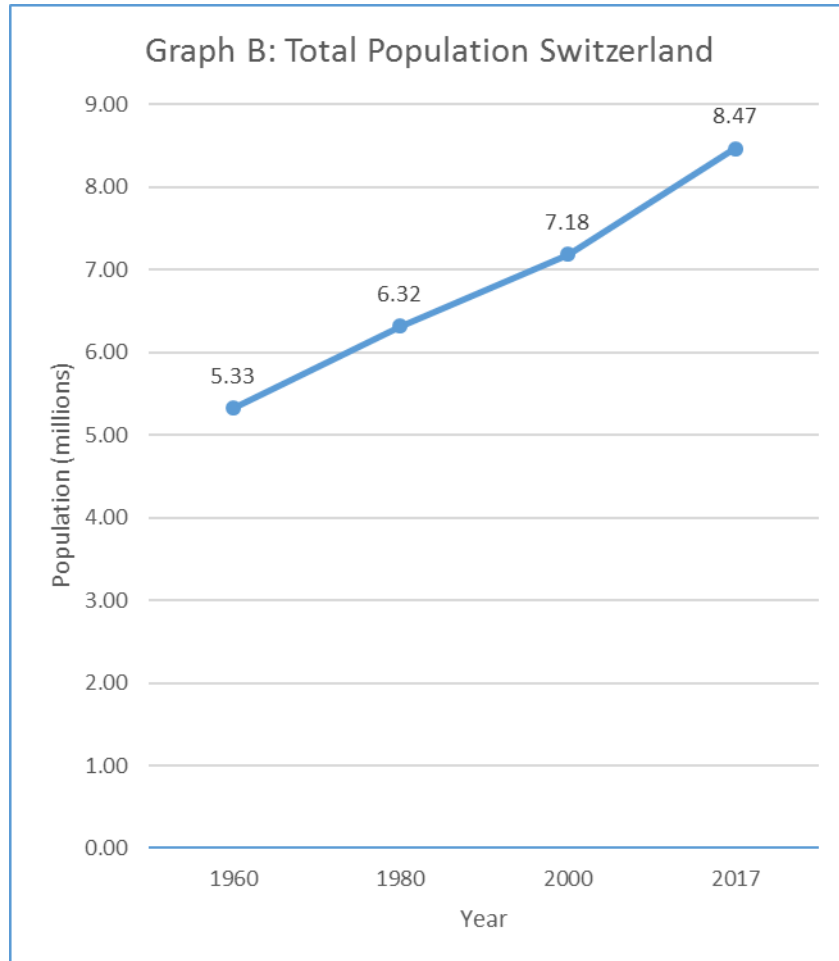
The population of Switzerland is 8,466,017 (World Bank, 2018a) and birth rate is estimated at 10.5 births/1,000 population in 2016 (World Bank, 2018b). The change in population and birth rate from 1960 to 2017 is shown in Figure 1, graphs A and B respectively.

Switzerland has a reported population density of 214 people per square kilometre in 2017 and this has risen from 138 people per square kilometre in 1961 (World Bank, 2018c). Infant mortality in 2017 is estimated at 3.7 deaths/1,000 live births in total (World Bank, 2018d).

The average life expectancy in Switzerland is estimated at 82.9 years (World Bank, 2018e), with a death rate of 7.8 deaths/1,000 population in 2016 (World Bank, 2018f). Switzerland has a gross national income per capita (PPP int. \$, 2013) of \$56,000 (WHO, 2016). The estimated total expenditure on health per capita in 2014 was \$6,468 (Intl \$) and the total expenditure on health in 2014 as percentage of GDP was 11.7% (WHO, 2016).



*Figure 1: Change in the Total Population and Birth Rate in Switzerland between 1960 and 2017*



Source: Information sourced from World Bank (2018)





#### **4 Vision Screening Commissioning and Guidance**

In Switzerland, vision screening is not embedded into a general preventative child healthcare screening system. It is organised regionally (Cantons) therefore differences exist between regions in relation to coverage, personnel delivering screening, tests used and funding. Vision screening is funded through either mandatory health insurance, the state or municipalities.

The content of the vision screening programme is decided upon by those professionals involved in screening within each region. There is no consensus on this, most often an official physician, (“cantonal doctor”) decides on the procedure. However, the screening content itself is managed by the performing personnel.

It is not known when vision screening began, or when it was implemented nationally. It is not known if the vision screening programme has been changed since its start date and there are no guidelines or general regulations for vision screening. If there are any revisions to a programme, this is decided upon on a regional basis with no regulations pertaining to how revisions take place or the funding of this work.

In Switzerland, paediatricians, midwives, nurses, specialist nurses, ophthalmologists, orthoptists and general practitioners (GP) conduct vision screening. It is not known how many of these professionals there are, per million population. No other general healthcare professionals have been identified that could deliver vision screening with additional training. Currently there is no specific training to perform vision screening, healthcare professionals gain this knowledge from their general training.

There are no methods for quality monitoring imposed by the government and no information is collected. There has been research carried out concerning the effectiveness of a vision screening programme in Switzerland (Eppenberger et al., 2016) which assessed the current local situation in the canton of St. Gallen and found that there was variation between locations. No research concerning the cost-effectiveness.



## 5 Screening programme

In Switzerland, the target conditions screened for include retinopathy of prematurity (ROP), congenital eye disorders, amblyopia, reduced visual acuity, refractive error, colour vision defects and strabismus. The health care professionals delivering vision screening, venue for screening and tests used vary depending on the age of the child as shown in Tables 1, 2 and 3 respectively. Specific details of the screening offered within each age group are described more fully in sections 5.1 to 5.4 below. It is also important to note that there is no consensus and therefore vision screening procedures vary depending on regions and/or professional screening. The information available and given below is generally indicative of Switzerland, but relates specifically to the Canton of St. Gallen.

### 5.1 Vision screening - Preterm babies

Preterm babies, up to the age of 3 months, are screened by an ophthalmologist in a neonatology department of a hospital. Preterm babies are determined as < 32 weeks gestational age and/or  $\leq$  1500 grams, or with oxygen supplementation > 3 days. Ophthalmoscopy (slit lamp examination if necessary) is performed according to the international guidelines. Otherwise, light reflex test is performed in the first week, month 1 and month 2 according to the guidelines of the Swiss Society of Paediatrics. The vision screening tests utilised include eye inspection, fixation and retinal examination; this is dependent upon age and weight.

### 5.2 Vision screening - Birth to 3 months

Well, healthy babies up to the age of 3 months are screened by either a paediatrician, midwife, specialist nurse, ophthalmologist or orthoptist. The vision screening tests administered at this age include eye inspection, fixation, retinal examination and pupillary reflexes. The screening is performed in the first week, month 1 and month 2. These tests are conducted in either a hospital, child healthcare centre, or a private clinic. Criteria that necessitate referral to an ophthalmologist for further diagnostic examination include any eye abnormality (e.g. leukocoria etc.). There are no consensus guidelines for referral, it is at the discretion of the examiner. Vision screening is not repeated, before referral for further diagnostic examination, children are referred immediately if they do not pass the screening procedure.

### 5.3 Vision screening - 3 months to 36 months

Infants aged from 3 to 36 months are screened by either a paediatrician, specialist nurse, ophthalmologist, orthoptist, optometrist/optician, or GP. The vision screening tests administered at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis (no consensus, most often Lang I and II, Titmus) and



colour vision (no consensus, most often Ishihara). Autorefraction (Retinomax Autorefractor) and automated screening (PlusOptix) are sometimes performed, but this depends on the examiner. These tests are conducted in either a hospital, child healthcare centre, kindergarten, school, private clinic, or public place.

Visual acuity (VA) is measured for the first time at age 2.5 years and the optotype charts used include Cardiff Acuity Cards, Lea symbols, Snellen, Tumbling E, Landolt C and Numbers. For each chart it is variable in terms of whether they are logMAR, linear, crowded or uncrowded charts, the range of optotype sizes used, or if different visual acuity charts are used for different ages and how this differs between regions. This is due to the fact that there is no consensus and it is dependent upon the preferences of the examiner. It is dependent upon the examiner as to when visual acuity is measured again and there is no consensus for this. VA is measured by either a paediatrician, specialist nurse, ophthalmologist, orthoptist, optometrist/optician, or a GP. Criteria that necessitate referral to an ophthalmologist for further diagnostic examination include VA of equal to or less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen), 1 or 2 lines difference in visual acuity, lacking stereovision, or any other eye abnormality (e.g. leukocoria). This is true for large cities including Zurich, however it depends on the individual screening as there are no consensus guidelines. Vision screening is not repeated, before referral for further diagnostic examination, children are referred immediately if they do not pass the screening procedure.

#### *5.4 Vision screening - 36 months to 7 years*

Children aged between 36 months and 7 years receive vision screening delivered by either a paediatrician, specialist nurse, ophthalmologist, orthoptist or a GP in hospitals, child healthcare centres, kindergarten, schools, private clinics, or public places. The vision screening tests administered at this age include eye inspection, fixation, red reflex testing, eye motility, Hirschberg test, pursuit movements, pupillary reflexes, cover test, alternating cover test, visual acuity measurement, stereopsis (no consensus, most often Lang I and II, Titmus) and colour vision (no consensus, most often Ishihara). Autorefraction (Retinomax Autorefractor) and automated screening (PlusOptix) are sometimes performed, but this depends on the examiner.

The optotype charts used include Cardiff Acuity Cards, Lea symbols, Snellen, Tumbling E, Landolt C and Numbers. Criteria that necessitate referral to an ophthalmologist for further diagnostic examination include a VA of equal to or less than 0.8 decimal (0.1 logMAR, 6/7.5 Snellen) 1 or 2 lines difference in VA, lacking stereovision, or any other eye abnormality (e.g. leukocoria etc.). This is true for large cities including Zurich, however it depends on the individual screening as there are no consensus guidelines. Vision screening is not repeated, before referral for further diagnostic examination, children are referred immediately if they do not pass the screening procedure.



**Table 1:** Healthcare professionals who conduct vision screening in each age group

<b>Table 1</b>	<b>Paediatrician</b>	<b>Midwife</b>	<b>Specialist Nurse</b>	<b>Ophthalmologist</b>	<b>Orthoptist</b>	<b>Optometrist</b>	<b>GP</b>
Preterm babies	x	x	x	✓	x	x	x
0 to 3 months	✓	✓	✓	✓	✓	x	x
3 to 36 months	✓	x	✓	✓	✓	✓	✓
3 to 7 years	✓	x	✓	✓	✓	x	✓



**Table 2:** Vision screening tests used in vision screening for each age group

Table 2	EI	Fix	RE	PR	RR	EM	Hir	PM	CT	ACT	VA	SV	CV	AR	AS
Preterm babies	✓	✓	✓	x	x	x	x	x	x	x	x	x	x	x	x
0 to 3 months	✓	✓	✓	✓	x	x	x	x	x	x	x	x	x	x	x
3 to 36 months	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3 to 7 years	✓	✓	x	x	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Key: EI: Eye Inspection; Fix: Fixation; RR: Red Reflex Testing; EM: Eye Motility; Hir: Hirschberg test; RE: Retinal Examination; PM: Pursuit Movements; PR: Pupillary Reflexes; CT: Cover Test; ACT: Alternating Cover Test; VA: Visual Acuity; SV: Stereopsis; CV: Colour Vision; AR: Autorefraction; AS: Automated Screening



**Table 3:** Location of vision screening for each age group

<b>Table 3</b>	<b>Hospital</b>	<b>Child Healthcare Centre</b>	<b>Kindergarten</b>	<b>Private Clinic</b>	<b>School</b>	<b>Public Place</b>
Preterm babies	✓	×	×	×	×	×
0 to 3 months	✓	✓	×	✓	×	×
3 to 36 months	✓	✓	✓	✓	✓	✓
3 to 7 years	✓	✓	✓	✓	✓	✓



## **6 Automated Screening**

Automated vision screening is achieved using handheld, portable devices designed to detect presence of refractive error from 6 months of age. It provides objective results and is used to detect amblyopic risk factors. This differs from other methods used to screen children for amblyopia that focus on detection of the actual condition and the resulting visual loss.

In Switzerland, the automated screening devices used are PlusOPTix and Retinomax autorefractor. Automated screening is only rarely performed, it depends on individual preferences of the examiner. Therefore, there is no information concerning:

- The ages at which these are performed
- If other tests are used too
- If all children, or just a select group of borderline/fails are tested with these
- If there is comparative data between regions that do and do not conduct these tests
- What the referral criteria are

The cost of these devices, the maintenance costs per year and after how many years a device is scheduled for replacement are not known.



## **7 Provision for Visually Impaired**

In Switzerland, there are 25 schools for blind or severely visually impaired children. The costs per child for these schools is not known. There is additional support for visually impaired children who attend regular mainstream primary school, in the way of vision aids such as magnifying glasses and special glasses. This differs between regions.





## **8 Knowledge of existing screening programme**

### *8.1 Prevalence/Diagnosis*

The prevalence of treated or untreated amblyopia by the age of 7 years is estimated to be 2-4% using the criteria of 2 or more lines difference in VA between the eyes. The prevalence of persistent amblyopia (missed by screening or failed treatment) by the age of 7 years (N=7,499) is 2% (Sturm et al., 2016). The prevalence of strabismus is 2-4% in preschool children (Sturm et al., 2016). The incidence (observed cases) of the four types of amblyopia (strabismic, refractive, combined mechanism and deprivation) is not known.

### *8.2 Coverage*

The percentage of children invited for vision screening is not known, and it is not known who invites children for general preventative child healthcare screening, or how this is conducted. The coverage of vision screening, before the age of 7 years is not known. The attendance rate of vision screening, before the age of 7 years is 80-90%, this is also true for the coverage of VA measurements as part of vision screening (Sturm et al., 2016). The percentage of compliance with referral after an abnormal screening test result is not known and it is unclear if there is registration or documentation of noncompliance with referral after an abnormal screening test result.

### *8.3 Screening evaluation*

The percentage of false negatives for vision screening, after the screening is completed is estimated at less than 10%. The percentage of false positives for vision screening is estimated at less than 10%. The positive predictive value of a refer result after vision screening is not known. The sensitivity and specificity of vision screening is not known.

### *8.4 Treatment success*

The estimated percentage of infants treated for congenital eye disorders in the total population is 0.1%. The estimated percentage of children treated for strabismus, after being screened before the age of 7 years is 2-3%. The estimated percentage of children treated for strabismus is also 2-3%. The estimated percentage of children treated for amblyopia, after being screened before the age of 7 years is estimated at 2-3%; this rises to 4% of all children treated for amblyopia before the age of 7 years. The number of patients treated for congenital cataract, amblyopia and strabismus, per year by orthoptists and/or ophthalmologists is 40,000 in Switzerland. Ophthalmologists and orthoptists are the only professionals that prescribe glasses for children under the age of 7 years. Other treatment options include patching, penalisation with glasses, atropine, strabismus surgery and cataract surgery. All eligible children are treated.



## **9 Costs of vision screening in children**

### *9.1 Cost of vision screening*

The actual salary costs per year for vision screening professionals is not known. However, the salary costs per hour for vision screening professional ranges from 50-150 CHF (44 to 131 Euros in October 2018). It is not known how much it costs to train general preventative child healthcare screening professionals between leaving secondary education to qualification. It is not known what the total screening costs, per year, for vision screening is in Switzerland. The total costs per child are also unknown.

### *9.2 Cost of treatment for amblyopia*

The estimated costs for treatment of typical patients with refractive amblyopia and strabismic amblyopia, including follow up, are not known.

### *9.3 Cost of Treatment for strabismus*

The estimated costs for strabismus surgery, including follow up, are not known.

### *9.4 Cost of treatment for cataract*

The estimated cost for congenital cataract surgery, including follow up of deprivation amblyopia, are not known.



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