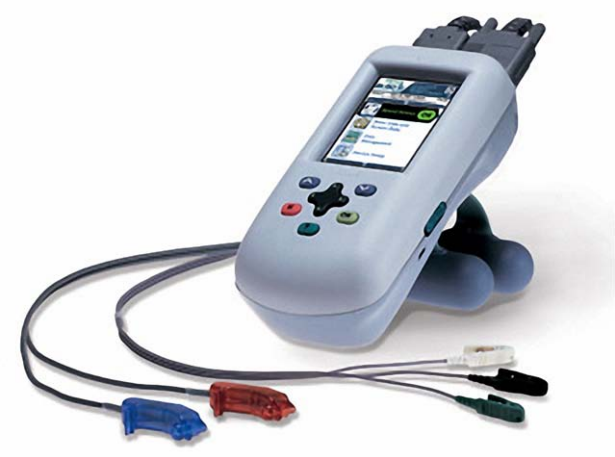
Hearing Screening, Report of 2008

Universal Hearing Screening in Flanders

Coverage, testresults and results of referred babies



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Introduction

Organisation of universal early hearing screening in Flanders using automatic brainstem audiometry (ALGO® hearing test).

- **Position Statement**

The Joint Committee on Infant Hearing and the American Academy of Pediatrics are setting the goal of generalised detection of congenital hearing abnormalities in newborns. This recommendation was confirmed by European bodies in the European Consensus Statement 2000 (Milan, 2000) and updated.

The European Consensus Statement was further updated by the biennial NHS symposia in Como, Italy. For example time limits were set for screening, diagnosis and starting rehabilitation and the otoacoustic emission test is no longer retained as an accepted screening method for high risk babies.

On 1 January 2009 636,000 children had already been tested shortly after birth with the ALGO® hearing test. The regional team members of Kind & Gezin have become real experts in carrying out the hearing test and with the arrival in 2007 of the successor to the ALGO® Portable device, the A3i device, they developed this skill further.

• Rationale

A serious congenital bilateral hearing impairment occurs in 1 to 1.4 per thousand newborns. A universal screening programme in Flanders would each year detect approximately 75 children with a severe bilateral hearing impairment.

In babies admitted to a neonatal intensive care unit (NICU), this risk is 10 to 15 times higher. For these babies the prevalence of bilateral and unilateral congenital hearing loss is respectively 1.9% and 0.6% (van Straaten 2001[1]).

Children with an auditory handicap lack the sensory stimulation that is a necessary condition for the development of speech. In addition this handicap has a pernicious effect on the total development of the personality in its social, emotional, intellectual and motor aspects.
Negative effects also occur in the educational process and in the parent-child interaction in the absence of auditory stimuli.

Research has shown that intensive rehabilitation, with auditory stimulation of the brainstem starting before the age of six months, gives children a significantly higher speech capacity than if children are only measured for a hearing aid at an age of seven to eighteen months.[2]

Up until 1997 the systematic detection of hearing problems in the Flemish Region was carried out with the distraction test (Ewing screening) or non-conditioned reaction audiometry from the age of nine months, corrected age. Home support and rehabilitation usually started after the age of eighteen to twenty four months, which is much too late. Also not all hearing impairments were detected with the distraction test.

Since 1998 Kind & Gezin has been screening babies for congenital hearing impairments using Automated Auditory Brainstem Response (A.A.B.R.) technology in newborns of around four weeks old, with the ALGO® newborn hearing screener made by Natus Medical Inc., San Carlos, CA, USA.

At the end of 2006 the current ALGO® 3i device was introduced in all Kind & Gezin regions. This device replaces the ALGO® Portable device used before that. The screening is carried out with a stimulus intensity of 35 dB. The screener software analyses the measured values and automatically shows the result on the screen as ‘OK (pass)’ or ‘refer’. A ‘refer’ result means that the device has not obtained statistical certainty of normal hearing. A new feature of the K&G version of the A3i device is the handy size, the simultaneous testing of both ears and the wireless uploading of child and test data to the K&G IKAROS databank. As a result the tests take less time and the system prevents recording errors. That is very important particularly for statistical data processing. The change-over to the ALGO® 3i in Flanders started in September 2006 and was completed in April 2007.

All hearing tests are carried out by the regional team members of Kind & Gezin. In case of a 'refer' result or 'test without result' the children are referred directly and exclusively to one of the 'referral centres'. These are specialist services which have committed themselves to ensuring a standard professional diagnosis and follow-up and to reporting the results among others to K&G, so that data can be generated at population level. The Flemish Minister of Health co-signed this protocol when the hearing screening project started up. Annexes 1 to 3 give an idea of the organisation in Flanders and the protocols followed. Annex 4 to this report give a list of referral centres.

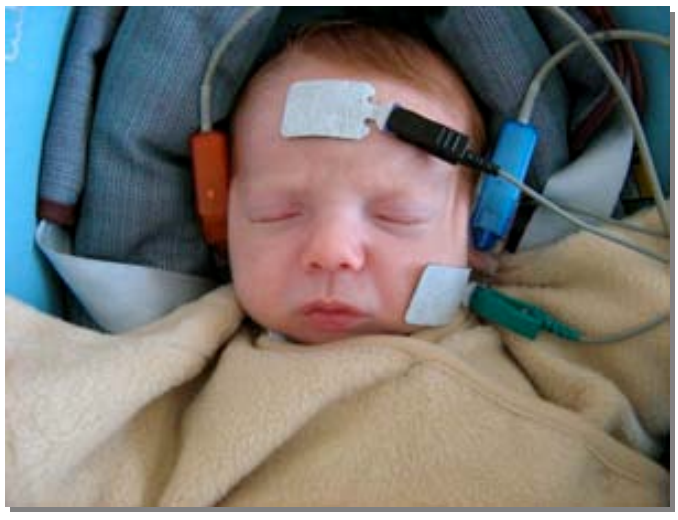
We are pleased to confirm that the early detection of congenital hearing loss, the diagnostic approach, the identification of possible risk factors but also home support, rehabilitation and where applicable treatment with a cochlear implant are being given increasingly more attention in the Flemish Region.

Research is being carried out in several places and symposia are being published. Above all there is now more clarity about the ultimate results of early detection and treatment for speech and language development and integration in the social and school environment. In Annex 5 we give the references of a few recent publications.

In this report we set out the results of hearing screening for the year 2008. We are restricting ourselves here to the data for screening and referral for which K&G itself is responsible. No analysis is carried out of for example the diagnoses made, the risk factors or the follow-up of the children referred. After all this requires more in-depth research.

NICU children are not included in chapters 1 to 4. In chapter 5 we give separately the available figures for NICU children.

The statistical evaluation of hearing screening can only be carried out after sufficient results have been received from the referral centres and hence there is a clear picture of any hearing loss. For this reason there is always a delay in the publication of the annual reports. The processing of the database data for this report was carried out between September 2009 and April 2010.



1. COVERAGE OF CHILDREN BORN IN 2008 AND LIVING IN THE FLEMISH REGION.

1.1 At Flemish Region level

In Table 1 we look at the extent to which a hearing test is offered to children who at their birth in 2008 lived in the Flemish Region and had not been admitted to a neonatal intensive care unit (NICU).

A hearing test was carried out on 66,030 (96.9%) of the 68,132 children registered by Kind & Gezin, born in 2008, living in the 'Flemish Region' and who had not been admitted to a neonatal intensive care unit, either by Kind & Gezin after discharge from a maternity unit, or by paramedics when still staying in a maternity unit. 0.9% of all children were not covered, where there was also no information available on a test being carried out in a maternity unit.
For 485 children with an incorrect record we do not know whether the hearing test was carried out before or after discharge from the maternity unit.
For 359 children no test was offered because of "test not applicable". This relates to children who died before the age of 6 weeks (NICU children who died before the age of 6 months) without a record of refusal to take a test.

In total 64,234 children were tested by Kind & Gezin district nurses. This is 94.3% of the total target group. The figure for children tested by Kind & Gezin does not include children tested by Kind & Gezin in a maternity unit; after all these children belong to the group "already tested in the maternity unit". All in all 96.9% of children born in 2008 and who at birth lived in the Flemish Region, were given a hearing test in the period after their birth. In 1.0% of children covered by Kind & Gezin, the test was refused. A refusal to take a test is only recorded if the parents did not turn up after repeated invitations or explicitly refused to take the test, which is exceptional.

Table 1: Coverage of children born in 2008 and living in the Flemish Region at birth (not including NICU).

TARGET GROUP COVERAGE	NUMBER	%
Children tested by Kind & Gezin	64,234	94.3
Already tested in maternity unit	1,796	2.6
SUBTOTAL: children tested	**66,030**	**96.9**
Test refused[1]	653	1.0
Incorrect record[2]	485	0.7
Not applicable[3]	359	0.5
Total children covered	**67,527**	**99.1**
Children not covered	605	0.9
Total children born in 2008	**68,132**	100

1.2 Per province

Table 2 sets out the data on coverage per province. The percentage of children tested by K&G is higher than 95% in the provinces of East-Flanders, West-Flanders, Limburg and Antwerp. Only in the province of Flemish Brabant is the target group coverage at 82.3% lower than the average target group coverage by K&G, but there 12.3% of the newborns were given a hearing test before leaving the maternity clinic, which is considerably more than in the other provinces.
We can see that ultimately 94.6% of children in Flemish Brabant were given a hearing test and between 96 and 98% in the other provinces.

The number of refusals for the hearing test is particularly low and in Limburg, West-Flanders and East-Flanders is 0.6% or less and in Antwerp just below 1% of the tests offered. Only in the province of Flemish Brabant is it slightly higher, where 2.4% of parents approached did not consider a hearing test by K&G to be important. Over the years there has been a continuing fall in the number of refusals. In 2002 this was still 3% of the tests offered.

1 Refusal means that parents did not turn up after repeated invitations or explicitly refused to take the test

2 Incorrect record means that there are conflicting data.

3 Not applicable: NICU children who died before the age of 6 weeks without a record of refusal

Table 2: Coverage of children born in 2008 per province, not including NICU.

TARGET GROUP COVERAGE	Antwerp	Flemish Brabant	Limburg	East-Flanders	West-Flanders
Children tested by K&G	95.8%	82.3%	97.1%	96.8%	97.5%
Already tested in maternity clinic	0.9%	12.3%	0.7%	0.9%	0.3%
SUBTOTAL: % children tested	**96.7%**	**94.6%**	**97.8%**	**97.7%**	**97.8%**
Test refused	0.9%	2.4%	0.4%	0.5%	0.6%
Incorrect record	0.9%	0.7%	0.9%	0.6%	0.5%
Not applicable	0.6%	0.4%	0.4%	0.6%	0.4%
% children covered	**99.1%**	**98.2%**	**99.5%**	**99.4%**	**99.3%**
% children not covered	0.9%	1.8%	0.5%	0.6%	0.7%
Total children born in 2008	**100% (n=20 409)**	**100% (n=11 267)**	**100% (n=8 538)**	**100% (n=16 107)**	**100% (n=11 766)**

2. OUTCOME OF HEARING TESTS IN CHILDREN BORN IN 2008 (EXCLUDING NICU)

The further analysis is also based on the tests of children, born in 2008. We show the total number of tests and split these into first and second test. We also look at how many tests were aborted because they took too long or because of conditions that interfered with the test (alert baby etc.) and could not be rectified immediately.

The age of taking the first test was also investigated. Were the tests taken within the predetermined period?

We also look at how many children obtained a 'pass' result and paid attention to the outcome of the second test after a first 'refer' or an aborted test. Children who were born at the end of 2008 were offered the test in 2009.

Since 2004 a failed test, after follow-up, was classed as a "refer" result. Specifically this means that after two successive tests without a "pass" result, the baby involved still had to be referred for audiological diagnosis. This new appointment was not yet used initially. The decision to do this was taken on the basis of research that showed that in children with a failed test, hearing loss occurs more often than in children who only get a "pass" result.
As a result the number of referrals increased slightly but the risk of missing a congenital hearing loss fell.

2.1 Number of hearing tests

In children born in 2008, in the Flemish Region 66,590 first and follow-up tests were carried out by Kind & Gezin, excluding NICU babies (Table 3).
After a first test all the follow-up tests for the same child count as a second test. Exceptionally a third test is carried out. This situation may occur if after the second test it is found that a previously minor problem led to a positive test result. If the order of first, second, third test could not be determined, these tests are shown in the box "order not determined". This may happen if a child was tested twice on the same day.

For 25 children a first test was taken twice. These are very young babies in whom a new risk of hearing loss was determined shortly after the first test with a 'pass' result. On the express request of the treating doctor a first hearing test was therefore repeated.

Exceptionally a test had to be aborted. This concerns 283 tests or 0.4% of the total number of tests (see Table 5).

The hearing test was usually carried out in the Kind & Gezin regional centre (64.3%) or in a clinic (35.6%) and exceptionally also on a home visit (0.1%). The intention is to cover all newborns with a hearing test via these three scenarios.

Exceptionally the hearing test is carried out at another place, such as in a preventorium, in an asylum centre, in a children's home or even in a maternity unit. This is always carried out by agreement and in the case of a test in a maternity unit only on the instructions of the treating doctor.

Table 3: Tests carried out by Kind & Gezin on children born in 2008, living in the Flemish Region at birth, broken down by first and second test.

TESTS	NUMBER	%
Number of first tests	64,259	96.5
Number of second tests	1,246	1.9
Number of third tests	69	0.1
Order of tests not determined	1,016	1.5
Total number of tests carried out	66,590	100

2.2 Age of testing for children born in 2008

Table 4 analyses the time of carrying out the hearing test by Kind & Gezin. The recommended age stipulated is before the age of one month, but the test can in principle be carried out reliably from birth.

Before the age of 4 weeks 67.3% of the first tests were carried out and over 94% during the first 6 weeks after the birth. Children, who are difficult to reach, or who miss a number of appointments, are given their hearing test a bit later. There is a small difference in the average screening age between one region and another.

Table 4: Age of children, born in the Flemish Region in 2008, at the time of the first hearing test (not NICU children).

AGE FIRST TEST	%
Less than 4 weeks	67.3
4 to 6 weeks	27.0
7 to 8 weeks	4.5
More than 8 weeks	1.2
Total first tests carried out	100

2.3 Outcome of hearing tests carried out in children born in 2008

Tables 5, 6 and 7 set out the results of the first hearing test.

98.0% of children born in 2008 and tested by Kind & Gezin obtained a 'pass' result in the first test. This means that any congenital hearing loss is less than 35dB and these babies have normal hearing.
1.6% of children obtained a 'refer' result in the first test for one or both ears. The details of the 'refer' result are set out in Table 6.
In addition 0.4% of the first tests were stopped prematurely because of unfavourable test conditions that could not be rectified immediately by the district nurse, such as restlessness in the baby, crying, vomiting or prominent ambient noise. If a test did not give a result after 20 minutes it was also aborted by the district nurse, because then the time investment becomes too great. These tests are recorded as 'fail'. A control test had to be carried out both for children with a positive test result and for children with a test stopped prematurely; Table 7 shows this result.

All in all 2.0% of children were eligible for a second test after a 'refer' or an aborted first test.

Table 5: Test outcome in children born in 2008 and living in the Flemish Region

TEST OUTCOME FIRST TEST	%
'Pass' in first test	98.0
'Refer' in first test	1.6
Aborted first test	0.4
Total children with a first test	100
To be retested after the first test as % of 1st test	2.0

The following Table gives the result of the positive tests in detail.

The A3i® device tests both ears virtually simultaneously, but a positive screening ends 10% more often with a 'refer' result for the left ear than for the right ear.

Table 6: Details of 'refer' results for the first test in children born in 2008 and living in the Flemish Region, where the first hearing test was positive.

REFER RESULT IN FIRST TEST	%
Bilateral 'refer'	20.2
Unilateral 'refer' right and negative left	34.9
Unilateral 'refer' left and negative right	44.9
Total	**100**

Most second tests were carried out within 48 hours, but in a different location from the first test to exclude any interfering ambient factors.

A number of children had already been referred after the first test with a 'refer' result, primarily on the insistence of their parents.

Table 7: Details of the result of the control test after a first failed test in children born in 2008 and living in the Flemish Region.

CONTROL TEST AFTER FAILED FIRST TEST	%
Pass	78.3
Refer	11.2
Fail	5.2
No control test carried out	5.2
Total	**100**

Table 7 shows how the control test, carried out after a prematurely aborted test ('fail'), for 78.3% gave a 'pass' result. For these children speech and language development is carefully monitored, because there was possibly a reason in the child itself for failing the first test. To date (April 2010) no hearing problem has been found in these children.

For 11.2% this control test gave a 'refer' result, seven times more than in the total target group. These children were referred to one of the 21 referral centres in Flanders for extensive diagnosis.

For 5.2% of children with a failed first test the control test was also a fail. These children were also referred to a referral centre.
For 5.2% of children after a failed test no control test was found. The procedure

determines that these children must be referred and the district nurse is reminded of this if she does not record a referral after a failed test without a control test.

Table 8: Test outcome second test in children born in 2008 and living in the Flemish Region (excluding NICU).

TEST OUTCOME SECOND TEST	%
Pass in second test	57.79
Referred after second test (‘refer’ or ‘fail’)	31.30
Deceased	0.07
Not carried out	10.84
Total	100
Refer rate second test as % of second test	35.13
Refer rate of two tests as % of first test	0.71

After a first positive test result a second test is as a rule carried out within 48 hours after the first test in the presence of a Kind & Gezin clinic doctor. For 10.84% of children, eligible for a second test after a first positive test, no second test was found. A number of them were referred immediately, some did not come back for the appointment for a second test because they immediately changed to a doctor who did not report; a number were given a third test with a pass result; for a number of them the second test was not recorded or recorded under the wrong code.

All in all after the first or second test 508 children, born in 2008 and living in the Flemish Region, were referred to one of the 21 referral centres.

3. INCIDENCE AND DEGREE OF HEARING LOSS IN CHILDREN BORN IN 2008 AND LIVING IN THE FLEMISH REGION

All the results of referred children are collected by Kind & Gezin so that a subsequent follow-up and reporting can be carried out. The missing reports are requested periodically and hence reporting is carried out in good time.

We show the results of the children referred in Table 9. At the time of processing these data we have the reports of all 508 babies referred. Compared with 2007 the number of referrals is virtually unchanged (-1.4%) and 20 fewer children were found with a confirmed perceptive hearing loss (-11.2%). The doubling of the number of referrals, already noticed in 2007 compared with 2006, continues in 2008. The A3i device seems to be more sensitive than its predecessor, the ALGO® Portable device.
For 159 of the 508 known results, or 31.3%, a permanent hearing loss was confirmed. For 267 children or 52.6% this was found to be a temporary but persistent conduction hearing loss. This means that for 83.9% of the children referred there was indeed hearing loss, and the referral was therefore correct. For 79 children, or 15.6%, a normal hearing was reported. These are the false positive referrals. For 3 referred children the diagnosis is still unclear.

Table 9: Referred children, born in 2008 and living in the Flemish Region: overview of the audiological diagnosis according to report from the referral centres

REPORTED DIAGNOSIS	NUMBER	%
Permanent hearing loss confirmed	159	31.3
Temporary hearing loss confirmed	267	52.6
Result not clear	3	0.6
Normal hearing	79	15.6
Total	508	100

The determination of the degree of hearing loss at a very young age is difficult and takes time. The determination of correct hearing thresholds is not easy in babies; sometimes the hearing loss changes temporarily, for example in case of poor ventilation of the middle ear, fluid-retention in middle ear with or without infection, immaturity etc. A conduction type hearing loss should be treated first because it can mask a neurosensory loss. The diagnostic process is taxing and parents sometimes need encouraging to postpone the tests; living abroad also makes monitoring difficult. Some children also

have multiple medical problems in which hearing loss is of secondary importance. Exceptionally a child may slip through meticulous follow-up and reappear after some time via the 'hearing impairment reporting point'.

The aim is that the diagnosis is completed before the age of three months, so that the treatment and any rehabilitation can start before the age of six months in case of a confirmed bilateral hearing loss.

In Table 10 the group of 159 children with permanent hearing loss is broken down into unilateral and bilateral hearing loss. This difference is important for the further diagnosis and for whether or not to start full rehabilitation. For 97 of the 159 children diagnosed or 61.0% bilateral hearing loss was found.

Table 10: Children, born in 2008 and living in the Flemish Region, with hearing loss: degree of hearing loss (incomplete results).

HEARING LOSS (ABR THRESHOLD)	UNILATERAL HEARING LOSS	%	BILATERAL HEARING LOSS	%	TOTAL	%
21 - 40 dB	6	9.7	20	20.6	26	16.4
41 - 70 dB	30	48.4	48	49.5	78	49.1
71 - 90 dB	13	21.0	16	16.5	29	18.2
>90 dB	13	21.0	13	13.4	26	16.4
Total	**62 (=39%)**	**100**	**97 (=61%)**	**100**	**159**	**100**

For 77 children, born in 2008, a bilateral hearing loss of more than 40 dB was found and confirmed. The incidence of bilateral hearing loss of more than 40dB was therefore 1.20 per 1000 newborns tested. This agrees with the data from the literature.

4. COMPARISON 2007 – 2008

The trend to screen at a slightly younger age did not continue in 2008: 67.3% were screened in the first month compared with 68.8% in 2007.
In the first test 98.0% obtained a pass result in 2008, compared with 97.9% in 2007. The number of children to be retested was 2.0% in 2008, which is the same level as the result for 2007 (2.1%).

After the second test 31.3% of children had a 'refer' or 'fail' result and were referred, which is an increase of 1.5% compared with 2007 (29.8%).

In Table 11 the coverage and results for 2008 are compared with 2007.
Most parameters over the years show slight variations without demonstrating a real trend. In 2008 the number of children tested by Kind & Gezin increased by 2,175 and hence in percentage terms remains at the same level as 2007.
The number of refusals also hardly changed (increase from 0.9% to 1.0%).

Table 11: Target group coverage and results – comparison 2007 with 2008 (not NICU).

TARGET GROUP RANGE	**2007**	**2008**
Number of children tested by K&G	62,059	64,234
% children from the target group tested by K&G	94.2%	94.3%
% refusal test in the target group	0.9%	1.0%
% incorrect record	1.1%	0.7%
% children of the target group covered by test offered	98.9%	99.1%
RESULT	**2007**	**2008**
Children referred after 'refer' or 'fail' 2nd test (‰ of the target group)	6.8 ‰	7.9 ‰
Confirmed hearing loss upon referral (% of referred)	399% (n=185)	31.3% (n=159)
Degree of hearing loss (% of the children referred) - unilateral bilateral	 46.1% 53.9%	 39.0% 61.0%
Incidence of bilateral hearing loss >40 dBnHL per 1 000 children tested	1.37 ‰ (n=85)	1.20 ‰ (n=77)

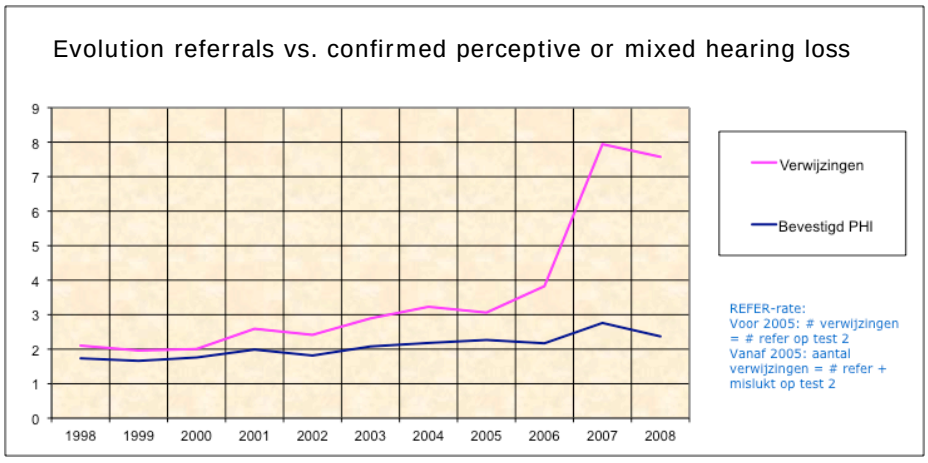
The refer rate after two tests, calculated on the total target group (with correct record), increased again in 2008 from 6.8 ‰ to 7/9 ‰. Of the children referred in 2008 there were however 0.6% more with a false positive test result. The incidence of bilateral congenital hearing loss found of ≥40 dB increased slightly by 0.17 per mille, which falls

within the variations of previous years. In 2007 this related to 85 children and in 2008 77 children, which corresponds with the theoretically expected number of around 75 per year in Flanders.

The changes in the results of referrals noted since the replacement of the ALGO® Portable by the ALGO® 3i in 2006 continued in 2008. The band width of the test sounds in the ALGO® 3i is slightly narrower, particularly in the high tones range there is less stimulation (0.7-5 KHz -> 0.7-4 KHz). The ALGO® 3i test is faster than its predecessor because both ears are tested at the same time or more accurately 'alternating quickly between right and left', but the device is more sensitive to interference and this possibly affects the results. When using the ALGO® Portable device the procedure was different: the two ears were screened in succession and so it was often noticed that the awareness of babies changed or the baby woke up when the test of the right ear stopped and that of the left ear started. The protocol for testing and referrals by K&G has however remained unchanged since the implementation of the ALGO® 3 device.

The A3i devices were originally supplied with English software, version 2.08. In 2007 the Dutch software, version 2.10, became available. Repaired devices were from then on upgraded to software version 2.13.

In spite of the fact that Natus formally states that the two devices have no differences that can affect the tests, the results obtained are different. The considerable increase in the number of referrals and more particularly the increase in the number of temporary middle ear problems found are striking and must be ascribed to the use of the ALGO® 3i.



Graph 1 : Evolution of referrals and confirmed hearing loss per 1000 infants, 1998-2008

'Verwijzingen' = Referrals; 'Bevestigd PHI' = Confirmed PHI
REFER rate:
For 2005: # referrals = # refer in test 2
From 2005 on: number referrals = # refer + failed in test 2

The percentage of confirmed congenital perceptive and mixed hearing losses with respect to of the number of referrals again fell by 8.6 percent. Over the period of the years 1998 to 2005 this ratio remained virtually stable, as shown in graph 1. Because in 2005 the procedure was adapted in the sense that a referral is not only made after a second positive test result but also after a second aborted test, the number of referrals increased slightly.

The number of parents who were unnecessarily distressed in 2008 by a repeated positive test result and for whom the baby still had normal hearing (false positive tests), is 15.6%. This is the same level as the results obtained with the ALGO® Portable device.

In over 1 in 2 referrals (52.6%) a middle ear problem was found to be the reason for the repeated failure of the hearing screening. To sum up in 2008 for 68.1% of the babies referred no congenital hearing loss was shown. Compared with the results obtained with the ALGO® Portable device this is over a tenfold increase. It should be noted here that this great increase can be explained by several factors. In the past ten years medical diagnosis and audiological development have advanced considerably and reporting has also become more accurate. The environment has also undergone changes and allergies occur more often and earlier. Audiologists and ear-nose-throat doctors are pleading for having children, who already show a middle ear problem at such a young age, closely medically and audiologically monitored because a temporary hearing problem can sometimes drag on for a long time and therefore have a negative effect on speech and language development. Nevertheless it is remarkable that since using the ALGO® 3i device the number of referrals has increased mainly due to the increase in the number of temporary middle ear problems.

The results of 2008 are being further analysed to obtain more understanding of these deviating results and to look for possible solutions.

A University department will also carry out a technical analysis of the ALGO® Portable and the ALGO® 3i.

5. HEARING SCREENING FOR CHILDREN ADMITTED TO A NICU

5.1. COVERAGE OF NICU CHILDREN

Children admitted to a Neonatal Intensive Care Unit (NICU) have a 10 times higher risk of a serious hearing impairment compared with newborns who do not receive intensive care at birth. A systematic and integrated programme of hearing screening is therefore very important for this population.

Kind & Gezin works with the intensive care units for premature babies to achieve early detection for this at-risk population, with the ultimate aim that all newborns are offered a hearing test and the results included in the screening database.
For a number of these high risk children the hearing test is not however a priority or not relevant. The hearing test is also more difficult to carry out in a standardised way.

At the moment Kind & Gezin still does not have all the test results for children admitted to a NICU department and it is also not always clear whether a child was admitted to a NICU department. Most NICU departments report the data monthly to K&G and lists are exchanged of children who slip through the net. Obtaining data for the departments located over the linguistic border is more difficult.

The following tables relate to children who are known by K&G as a NICU child and whose hearing screening results are known.

We can see that for some 91.5% of NICU children known by K&G hearing screening was carried out by a district nurse of K&G itself or by the NICU department.

The Joint Committee on Infant Hearing stated in 2007[1] that babies admitted to a neonatal intensive care unit for more than 5 days should be screened with brainstem audiometry. The use of an otoacoustic emission test as screening method is not recommended for these children.

1 . PEDIATRICS VOLUME 120, NUMBER 4, OCTOBER 2007

Table 12: Coverage of hearing screening for NICU children, born in 2008 and living in the Flemish Region, and known as such by K&G.

TARGET GROUP COVERAGE	NUMBER	%
NICU children tested by K&G	1,402	59.1
Already tested in intensive neonatology	770	32.4
Subtotal: Total NICU children tested	**2,172**	**91.5**
Test refused	31	1.3
Incorrect record[1]	13	0.5
Not applicable[2]	105	4.4
Total children covered	**2,321**	**97.8**
Children not covered	53	2.2
Total NICU children born in 2008	**2,374**	**100**

5.2. TEST OUTCOME FOR NICU CHILDREN

Tables 13 and 14 give the test results for respectively the first and second test for NICU children.

For 95.8% of NICU children, born in 2008, in the first test a 'pass' result (normal hearing) was recorded.
For 3.6% of NICU children tested the first test resulted in a 'refer'. This is more than double that in the population of term newborns. Also 0.6% of the first tests were terminated early because of unfavourable test conditions. This is almost half more than for the non-NICU population. These children had to be tested again.
4.2% of NICU children were eligible for a 2nd test after 'refer or 'fail' 1st test.

1 Incorrect record means that there are conflicting data.

2 Not applicable: NICU children who died before 6 months without a record of refusal

Table 13: Test outcome first test for NICU children born in 2008 and living in the Flemish Region, and known as such by K&G.[1]

TEST OUTCOME FIRST TEST	%
'Pass' in first test	95.8
'Refer' in first test	3.6
Children with an aborted first test	0.6
Total children with a first test	**100**

Table 14: Test outcome second test for NICU children born in 2008 and living in the Flemish Region, and known as such by K&G.

TEST OUTCOME SECOND TEST	%
'Pass' in second test	61.5
'Refer' in second test	34.4
'Fail' in second test	4.1
Total children with a second test	**100**

For 61.5% of children who underwent a second test this led to a 'pass' result. The speech and language development for these children was monitored with particular care. Until the publication of this report no hearing impairment had been established for this group.

For 34.4% the second test also resulted in a 'refer'. They were referred to one of the 21 referral centres. For 4.1% of NICU children the second test was aborted and these babies were also referred to a referral centre.

For the NICU children who were referred we do not have an analysis of the hearing losses confirmed.

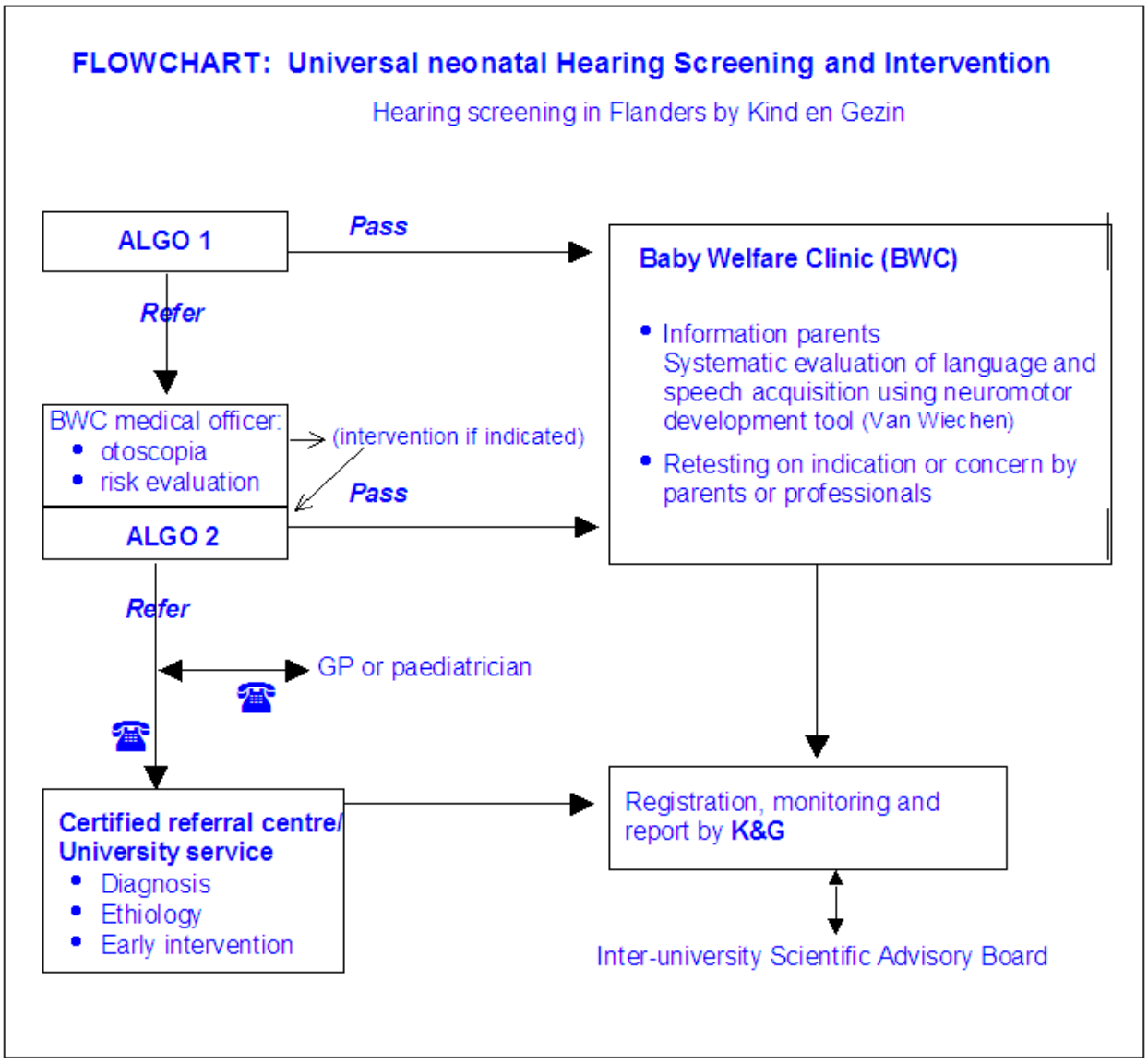
1 Screening is carried out either by Kind & Gezin or by NICU department.

6. EVENTS IN 2008

12 March:	Artevelde Hogeschool, Ghent: IPAC International training project for audiology students
07 April:	Meeting with Judith Marlowe, (Fellow, American Academy of Audiology; American Speech-Language-Hearing Association Certificate of Clinical Competence (CCC-A); Founding Director, Auditory-Verbal International (AVI) 1987-2006, AVI President ,1991-1993; Founding Director, AG Bell Academy for Listening and Spoken Language)
10 April:	University Hospital (UZ) Antwerp, Intensive course ENT training
18 to 21 June:	Cernobbio, Italy: NHS 2008 conference
03 October:	Academy K&G Brussels: Overview 10 year hearing screening in Flanders with presentation by Prof. Fernando Grandori
04 November:	Book by S.I.G. “begeleiden van een kind met een C.I.” (Supporting a child with a C.I.) available via K&G intranet
1 December:	Academy K&G Brussels: Hearing induction course for new K&G staff
5 December:	Academy K&G Brussels: meeting hearing referral centres and NICUs
11 December:	Early and home support Antwerp: Advisory Council.

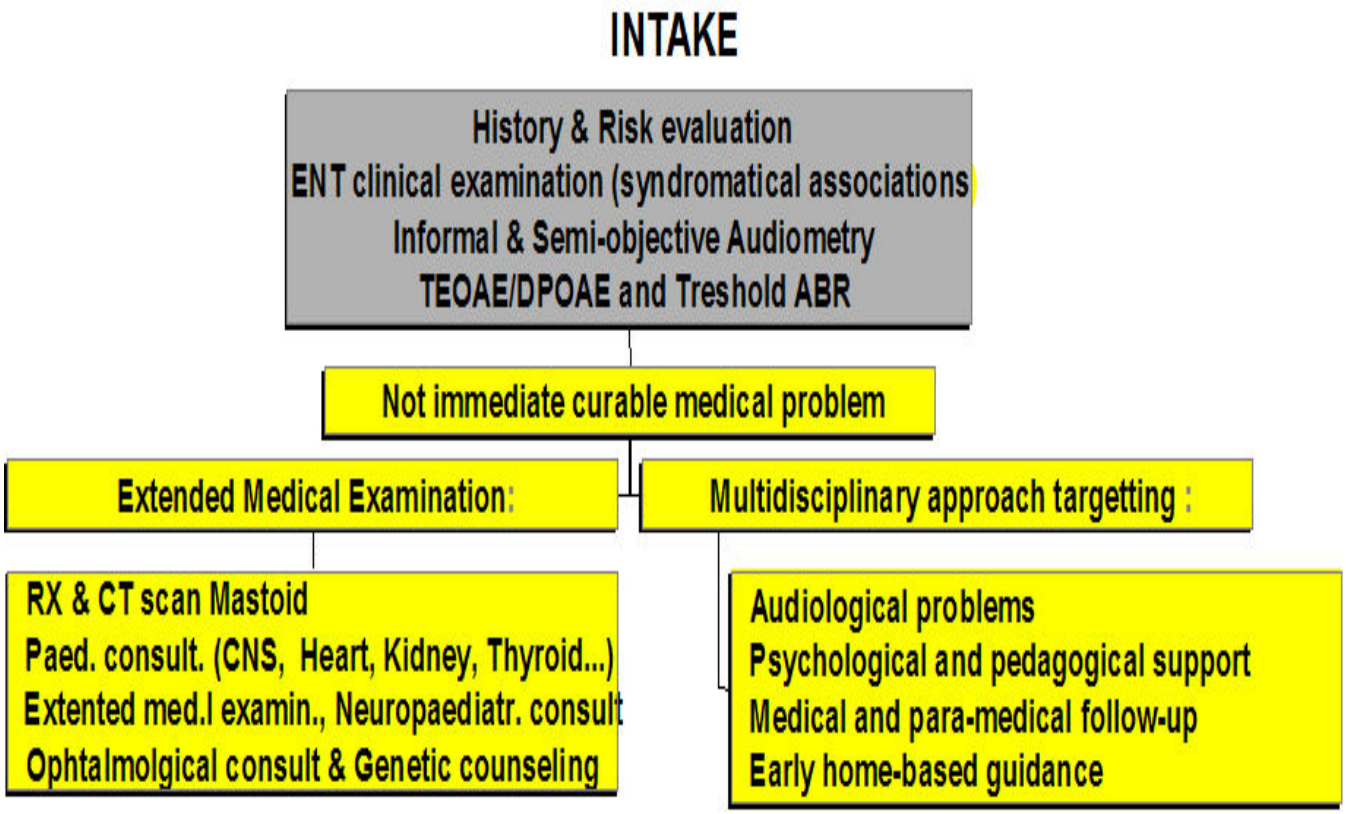
ENCLOSURE 1

ORGANISATION OF HEARING SCREENING IN FLANDERS



ENCLOSURE 2

PROTOCOL MINIMALE DIAGNOSTISCHE ONDERZOEKEN,
MULTIDISCIPLINAIRE SURVEY EN INTEGRALE BENADERING



ENCLOSURE 3

RECENT PUBLICATIONS ON THE FLEMISH NHS PROGRAMME

- *E. Van Kerschaver, A. Boudewyns, L. Stappaerts, F. Wuyts, P. Van de Heyning*
  Organisation of a universal newborn hearing screening programme in Flanders.
  B-ENT, 2007, 3, 185-190

- *F. Declau, A. Boudewyns, J. Van den Ende, A. Peeters, P. van den Heyning*
  Analysis of 170 Referred Neonates, Etiologic and Audiologic Evaluations After Universal Neonatal Hearing Screening . *Pediatrics* 2008;121;1119-1126;

- *N. Verhaert, M. Willems, E. Van Kerschaver, C. Desloovere*
  Impact of early hearing screening and treatment on language development and education level: Evaluation of 6 years of universal newborn hearing screening (ALGO®) in Flanders, Belgium; Presented at the Annual Meeting of the Belgian ENT Society, Leuven, Belgium, 17—18 November 2006; *International Journal of Pediatric Otorhinolaryngology (2008) 72, 599—608*

- *J. Verbeeck, E. Van Kerschaver, E. Wollants, K. Beuselinck, L. Stappaerts, M. Van Ranst;*
  Detection of Perinatal Cytomegalovirus Infection and Sensorineural Hearing Loss in Belgian Infants by Measurement of Automated Auditory Brainstem Response
  Journal of Clinical Microbiology Nov.2008, p 3564-3568

QUOTED REFERENCES

1. American Academy of Pediatrics, Joint Committee on Infant Hearing (2007). Year 2007 position statement: Principles and guidelines for early hearing detection and intervention programs. *Pediatrics*, *120*(4), 898-921.
2. van Straaten, H. L., Tibosch, C. H., Dorrepaal, C., Dekker, F. W., & Kok, J. H. (2001). Efficacy of automated auditory brainstem response hearing screening in very preterm newborns. J Pediatr, 138(5), 674-8.
3. Yoshinaga-Itano C, Sedey AL, Coulter DK, Mehl AL. Language of early- and later-identified children with hearing loss. Pediatrics 1998; 102: 1161-1171.

ENCLOSURE 4

Organisation of a universal newborn hearing screening programme in Flanders.

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Abstract. *Organisation of a universal newborn hearing screening programme in Flanders. Objective*: Since 1998 an integrated universal newborn hearing screening programme (UNHSP) based on automated auditory brainstem response (AABR) has been implemented in Flanders. The protocol of the UNHSP is based on guidelines defined by the American Academy of Paediatrics (AAP). The aim of this paper is to report on the screening protocol and to assess its feasibility. *Methodology*: Descriptive study based upon an analysis of the screening results in the neonatal non-NICU population of Flanders between 1999 and 2004. The UNHSP, organized by Kind en Gezin (K&G), uses a 2-stage protocol: children with a refer at the first screening test are retested, and those with a refer at the retest are referred to a certified centre. Screening and referral centres communicate their data to a central database at K&G. *Results*: From the beginning of 1999 until the end of 2004 a screening was offered to 97.91% of all eligible babies in Flanders; 91.5% of these babies were screened by K&G using the Algo® Portable Newborn Screener. Three-quarters of the referred babies had a confirmed hearing loss. In 57.6% of these babies, hearing loss was bilateral. Some babies had a temporary hearing problem. The false positive rate after two tests was 0.53 ‰ . All ascertained babies started early intervention, most of them before the age of 4 months. *Conclusions*: K&G has succeeded in organizing a new, well-structured community-based UNHSP according to the guidelines of the AAP on Neonatal Hearing Screening.

B-ENT, 2007, 3, 185-190