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**Type of Submission – Check all that apply:**
- [x] New Policy*
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**CPB 0700 Rhinometry and Rhinomanometry**

Policy is new to Aetna Better Health of Pennsylvania.

Name of Authorized Individual (Please type or print):

Dr. Bernard Lewin, M.D.

Signature of Authorized Individual:

[Signature]
Rhinometry and Rhinomanometry

Policy

*Please see amendment for Pennsylvania Medicaid at the end of this CPB.*

Aetna considers rhinomanometry, acoustic rhinometry, and optical rhinometry experimental and investigational because of a lack of clinical studies demonstrating that these tests improve clinical outcomes.

Background

There are many potential causes for nasal obstruction. Some of the most common causes are allergic rhinitis, deviation of the nasal septum, or sinus or nasal infection. Nasal obstruction is typically diagnosed by a patient’s subjective complaint of nasal stuffiness coupled with a physical examination demonstrating anatomic restriction of the nasal passages.

Rhinomanometry and acoustic rhinometry are objective tests that have been attempted to assess nasal airway patency. Rhinomanometry measures air pressure and the rate of airflow during breathing. These measurements are then used to calculate nasal airway resistance. Acoustic rhinometry uses a
reflected sound signal to measure the cross-sectional area and volume of the nasal passage. Acoustic rhinometry gives an anatomic description of a nasal passage, whereas rhinomanometry gives a functional measure of the pressure/flow relationships during the respiratory cycle. Both techniques have been used in comparing decongestive action of antihistamines and corticosteroids and for assessment of an individual prior to or following nasal surgery.

Some investigators have found that subjective symptoms as rated by patients frequently do not correlate with rhinomanometry and acoustic rhinometry measurements (Passali et al, 2000). In addition, significant symptoms can be present without airway restriction (e.g., in patients with atrophic mucosa or sinusitis). In a clinical trial (n = 49) on the role of acoustic rhinometry in the diagnosis of adenoidal hypertrophy, Riechelmann et al (1999) reported that acoustic rhinometry, in general, is not suitable for assessing adenoidal size in pre-school children. He found that acoustic rhinometry was not able to differentiate controls from symptomatic children admitted for adenoidectomy.

Pallanch et al (1998) stated that there are many objective test values where some patients will complain of obstruction but others will not. It follows that there is not a single population threshold for the airway at which symptomatic obstruction would occur. Instead, it appears that there is a range of individual threshold values. Thus, it is not always possible to identify who will feel obstructed based on airway data.

There is inadequate evidence of the clinical utility of rhinomanometry and acoustic rhinometry. These tests have not been demonstrated to be superior to physical examination, nasal endoscopy or computed tomography (CT) imaging in selecting patients who would benefit from medical and/or surgical management of their nasal obstruction. Clinical studies published in the peer-reviewed medical literature are
necessary to determine the value of rhinomanometry and acoustic rhinometry in the diagnosis and clinical management of patients with nasal obstruction.

Tarhan et al (2005) compared acoustic rhinometry (AR) data to CT data to evaluate the accuracy of AR measurements in estimating nasal passage area and evaluated its ability of quantifying paranasal sinus volume and ostium size in live humans. Twenty nasal passages of 10 healthy adults were examined by using AR and CT. Actual cross-sectional areas of the nasal cavity, sinus ostia sizes, and maxillary and frontal sinus volumes were determined from CT sections perpendicular to the curved acoustic axis of the nasal passage. Nasal cavity volume (from nostril to choana) calculated from the AR-derived area-distance curve was compared with that from the CT-derived area-distance curve. AR measurements were also done on pipe models that featured a side branch (Helmholtz resonator of constant volume but 2 different neck diameters) simulating a paranasal sinus. In the anterior nasal cavity, there was good agreement between the cross-sectional areas determined by AR and CT. However, posterior to the sinus ostia, AR over-estimated cross-sectional area. The difference between AR nasal volume and CT nasal volume was much smaller than the combined volume of the maxillary and frontal sinuses. The results suggested that AR measurements of the healthy adult nasal cavity are reasonably accurate to the level of the paranasal sinus ostia. Beyond this point, AR over-estimates cross-sectional area and provides no quantitative data for sinus volume or ostium size. The effects of paranasal sinuses and acoustic resonances in the nasal cavity are not accounted for in the present AR algorithms.

Cakmak et al (2005) evaluated how anatomic variations of the nasal cavity affect the accuracy of AR measurements. A cast model of a human nasal cavity was used to examine the effects of the nasal valve and paranasal sinuses on AR measurements. A luminal impression of a cadaver nasal
cavity was made, and a cast model was created from this impression. To simulate the nasal valve, inserts of varying inner diameter were placed in the model nasal passage. To simulate the paranasal sinuses, side branches with varying neck diameters and cavity volumes were attached to the model. The AR measurements of the anterior nasal passage were reasonably precise when the passage area of the insert was within the normal range. When the passage area of the insert was reduced, AR measurements significantly underestimated the cross-sectional areas beyond the insert. The volume of the paranasal sinus had limited effect on AR measurements when the sinus ostium was small. However, when the ostium size was large, increasing the volume of the sinus led to significant over-estimation of AR-derived areas beyond the ostium. The authors concluded that the pathologies that narrow the anterior nasal passage result in the most significant AR error by causing area under-estimation beyond the constriction. It also appears that increased paranasal sinus volume causes over-estimation of areas posterior to the sinus ostium when the ostium size is large. If these physical effects are not considered, the results obtained during clinical examination with AR may be misinterpreted.

Liu et al (2006) examined the association between AR findings and results of over-night polysomnography. Patients who were under the age of 20 years, had severe deviated nasal septum, had previously received nasal or palatal surgery, or could not complete sleep test or AR examination were excluded. Subjects' basic data including age, gender, neck circumference, and body mass index (BMI) were collected. All participants received AR before over-night polysomnography. The results along with sleep-test outcomes were recorded and analyzed. A total of 87 patients were included in this study. Patients with respiratory disturbance index (RDI) less than 5/hour (n = 26) or with RDI of 5 - 30/hour (n = 28) tended to have larger minimal cross-sectional area (MCA) compared with those of patients whose RDI was more than 30/hour (n = 33) (p = 0.001). A stepwise multiple regression analysis
showed that BMI, male gender, and MCA were contributing factors in RDI. The R2 value of the multiple regression analysis was 0.406. The authors concluded that patients with severe obstructive sleep apnea tended to have smaller MCA when compared with patients with RDI less than 30/hour. However, it was hard to predict whether patients had obstructive sleep apnea from AR examination.

Bermüller and colleagues (2008) examined the diagnostic accuracy of rhinomanometry (RMM) and peak nasal inspiratory flow (PNIF) in functional rhinosurgery. Measurements were carried out on 40 healthy individuals and 53 patients with symptomatic nasal stenosis. Cut-offs for RMM and PNIF were defined by receiver operating characteristic analysis. A cut-off between normal and pathological of 700 ml/second for RMM at a trans-nasal pressure difference of 150 Pa, and of 2,000 ml/second (120 L/minute) for PNIF was calculated. No significant differences in terms of sensitivity of RMM and PNIF (0.77 versus 0.66), specificity (0.8 versus 0.8) and diagnostic accuracy (0.79 versus 0.72) were found. The authors concluded that RMM and PNIF provide valuable information to support clinical decision making. However, with both methods, about 25% of symptomatic patients with functionally relevant nasal structural deformity were not detected. Furthermore, a negative test outcome of RMM or PNIF does not exclude a functionally relevant nasal stenosis.

Straszek and associates (2008) stated that despite a growing number of studies using AR in children, no reference material exists that incorporates the entire age and height interval of pre-school children up to puberty for a range of rhinometric variables. These researchers attempted to provide a reference range for nasal volumes and MCAs in healthy non-decongested children aged 4 to 13 years old. A total of 256 primary school children (mean age of 7.95 years; range of 3.8 to 13.1 years; 123 boys/133 girls) were measured by AR. Variables were MCA (first, second, and absolute minimum)
and nasal volumes from 0 to 4 cm (Vol0-4), 0 to 5 cm (Vol0-5),
1 to 4 cm (Vol1-4), and 2 to 5 cm (Vol2-5) into the nasal
cavity. Height and weight were measured and atopic status
was determined by skin-prick test. Age as well as current and
past respiratory health were recorded from a questionnaire. In
multiple linear regression models, height was the main
predictor for all AR variables although weight also was a
significant predictor of MCAs. There was no association
between any AR variables with sex, atopy, or hay fever; but
children with current wheeze (within last 12 months) and
asthma had decreased nasal patency. The authors concluded
that this study presented the most extensive current reference
material for AR in non-decongested pre-pubescent healthy
children. They stated that the presented reference material
will aid the interpretation and evaluation of future and present
epidemiological studies based on AR in children.

Piszcz et al (2008) reported on the use AR in assessing nasal
obstruction due to adenoid hypertrophy in patients referred for
adenoidectomy; they also evaluated on changes in the volume
of the nasopharynx after adenoidectomy. The examination
was performed in patients (n = 30) aged 5 to 10 years with
adenoid hypertrophy admitted for adenoidectomy. Ten
children who are free of otolaryngological problems served as
the control group. All subjects had AR performed and
additionally, endoscopic method such as rhynofiberoscopy and
endoscopy of nasopharyngs were introduced in the patient's
group. The study showed that children with adenoid
hypertrophy have statistically significant reduction of
nasopharyngeal volume (NPV) versus the control group.
Adenoidectomy increases the NPV parameter and makes it
equal to control group. The authors concluded that AR seems
to be a promising method in the assessment of
nasopharyngeal volume. They noted that this and further
studies may help to reduce the number of "unnecessary"
adenoidectomies, by making standards for NPV in different
group of age.
Okun and colleagues (2010) evaluated the use of AR in children with obstructive sleep apnea (OSA). Subjects with clinically suspected OSA underwent AR measurements followed by attended over-night polysomnography. Of a total of 20 subjects (13 boys, 7 girls), 15 (75 %) had OSA, defined as apnea-hypopnea index (AHI) greater than or equal to 5 events per hour of sleep, and 5 had primary snoring (PS). The mean AHI was 16.79 versus 1.96 events/hour. Positional changes in airway measurement by AR were present in the OSA group, with an average decrease in nasal cavity volume from upright to supine position of 1.53 cm\(^3\) (\( p = 0.027 \)). These changes were predictive of sleep apnea (\( r (2) = 0.65, p = 0.035 \)). The authors concluded that these findings showed a marked difference between OSA and PS groups during AR measurements of the nasopharynx. They stated that positional airway changes had been previously reported in adults with OSA and further evaluation of the airway function in pediatric OSA is warranted.

Andre and colleagues (2009) evaluated the correlation between the subjective sense of nasal patency and the outcomes found with rhinomanometry and AR. Review of English-language articles in which correlations were sought between subjective nasal patency symptoms and objective scores as found with rhinomanometry [nasal airway resistance (NAR)] and AR [minimal cross-sectional area (MCA)]. Correlations were related to unilateral or combined assessment of nasal passages and to symptomatic nasal obstruction or unobstructed nasal breathing. A total of 16 studies with a level of evidence II-a or II-b fit the inclusion criteria and were further analyzed. Almost every possible combination of correlations or lack thereof in relation to the variables included was found. However, when obstructive symptoms were present, a correlation between the patency symptoms with nasal airway resistance and minimal cross-sectional area was found more often than in the absence of symptoms. In cases of bilateral assessment a correlation was found almost as often as it was not between patency
symptoms and total nasal airway resistance or combined minimal cross-sectional areas, while in the limited amount of studies in which unilateral assessment was done a correlation was found each time between patency symptoms and nasal airway resistance. The authors concluded that the correlation between the outcomes found with rhinomanometry and AR and an individual's subjective sensation of nasal patency remains uncertain. Based on this review, it seems that the chance of a correlation is greater when each nasal passage is assessed individually and when obstructive symptoms are present. There still seems to be only a limited argument for the use of rhinomanometry or AR in routine rhinologic practice or for quantifying surgical results.

Kupczyk et al (2010) evaluated AR as an objective method of assessment of nasal lysine aspirin (Lys-ASA) nasal challenge. A total of 20 patients with aspirin induced asthma (ASA-S) and 10 controls (ASA-NS): 5 patients with allergic rhinitis and 5 healthy subjects) were included. Nasal challenge was performed with placebo (saline) and 14.4 mg of Lys-ASA introduced as aerosol to both nostrils (total dose: 16 mg of acetylsalicylic acid). Measurements of nasal volume bilaterally were performed with the use of AR before and 1, 2, 4 and 24 hours after the challenge. For further analysis the sum of both nasal cavities volume at the level of 2 to 5 cm from nostrils was used. Mean total bilateral volume in ASA-S group after placebo was: 7.74, 6.21, 7.11, 7.12, 7.24 cm$^3$ and 7.24, 5.77, 6.31, 6.27, 6.98 cm$^3$ after Lys-ASA (before and after 1, 2, 4 and 24 hours, respectively; p = 0.048 and p = 0.02, in 2nd and 4th hour, Lys-ASA versus placebo, Wilcoxon's test). With cut-off point of nasal volume decrease by 10 % in the 1st hour the sensitivity of the test was 70 %, specificity 60 %, positive predictive value 77.78 % and negative predictive value 50 %. The authors concluded that AR with measurement of nasal cavities volume changes at 2 to 5 cm from nostrils does not appear to be sufficiently sensitive and specific as a single method for evaluation of studied challenge method.
Optical rhinometry (ORM) is a new technique introduced in Germany in 2004 that quantifies light extinction in optical density to assess nasal blood volume as a measure of nasal patency. It works via optical spectroscopy, which measures the absorption of visible and near-infrared light in tissue. Similar to pulse oximetry that measures hemoglobin absorption of near-infrared light and thus oxygen blood saturation, ORM measures blood volume within the nasal cavity. An emitter and detector are positioned across the nasal bridge, and swelling is measured as the extinction of light or optical density, as a function of time.

Hellgren and colleagues (2007) validated the Rhinolux (Rhios GmbH, Germany), an optical rhinometer, against AR in detecting nasal mucosal swelling when changing body position from sitting to supine. The study population consisted of 20 healthy subjects (7 women, 13 men, mean age of 34.7 +/- 9.3 years). The Rhinolux was applied sitting in the upright position followed by 5 mins in the supine position. Acoustic rhinometry was measured sitting in the upright position and after 5 mins in the supine position. In 7 subjects the measurements were repeated on 3 different days to assess the repeatability. The mean change from baseline in minimal cross sectional area DeltaMCA measured with acoustic rhinometry was -0.12 (+/- 0.19) cm² (right + left side), p = 0.013 but DeltaE (change in light extinction from baseline) measured with the Rhinolux was unchanged 0.02 (+/- 0.18) optical densities (OD), p = 0.56. There was no correlation between DeltaE and DeltaMCA r = 0.028, p = 0.9. The mean DeltaE result from repeated measurements on different days was 0.05 (+/- 0.08) OD, p = 0.09 and the DeltaMCA was -0.1 (+/- 0.11) cm², p = 0.02. This study showed that the changes in nasal blood volume measured with the Rhinolux did not reflect changes in nasal mucosal swelling measured with AR when changing body position from sitting to supine. The results indicated that the utility of the Rhinolux in assessing nasal mucosal reactions has to be evaluated further.
In a prospective pilot study, Luong et al (2010) evaluated ORM as an objective evaluation of nasal patency using nasal provocation testing (NPT) with histamine and oxymetazoline. A total of 5 adult subjects with allergic rhinitis and 5 adult normal subjects who underwent challenge with histamine and oxymetazoline were included in this study. Patients underwent challenge with increasing concentrations of histamine to determine the amount of histamine needed to cause a positive ORM reading. The same subjects then underwent histamine challenge with this amount followed by oxymetazoline. Nasal patency was assessed subjectively after each challenge with the visual analog scale. The median histamine amount needed to cause a positive response was statistically lower in allergic rhinitis as compared with non-allergic subjects at 150 microg and 300 microg, respectively (p = 0.04). When comparing ORM with subjective nasal congestion after histamine and oxymetazoline challenges, there was a statistically significant correlation with r = 0.79 (p = 0.00003). The authors concluded that the findings of this pilot study demonstrated a correlation between subjective symptoms of nasal patency and objective measurements with ORM. Less histamine amount necessary to incite nasal congestion in allergic rhinitis suggests that these patients may be primed to the effects of histamine. They stated that these preliminary findings serve to create the foundation for further exploration of the utility of ORM for NPT.

In a prospective pilot study, Cheung et al (2010) assessed ORM as an objective evaluation of nasal patency using NPT with Dermatophagoides farinae (DF) as compared with AR. A total of 5 adult healthy controls and 5 adult subjects with allergic rhinitis underwent NPT with increasing concentrations of DF while undergoing ORM. The minimum concentration of DF causing a positive reading was recorded. Nasal cross-sectional area was measured before and after testing using AR. Nasal patency was assessed subjectively after each challenge with the visual analog scale. The median amount of DF causing a positive response on
ORM was less in allergic rhinitis patients as compared to healthy controls, at 5000 AU/ml and greater than 10,000 AU/ml, respectively. There was a statistically significant correlation between the change in optical density in ORM and subjective nasal congestion after increasing Df challenges \((r = 0.63; p = 0.0007)\). Similarly, there was a statistically significant correlation between change in optical density by ORM and both minimum cross-sectional areas as measured by AR \((r = -0.60, p = 0.03;\) and \(r = -0.64, p = 0.02,\) respectively). The authors concluded that this is the first study to show a correlation between ORM and AR during NPT with Df. In addition, the data support a correlation of ORM to subjective symptoms of nasal congestion. These findings suggest that ORM is able to assess changes in nasal patency during challenges with Df. They stated that further studies on ORM are needed; current ongoing trials are evaluating ORM for NPT with other common antigens.

Tombu et al (2010) stated that AR and RMM study 2 different parameters of nasal ventilation: (i) respiratory function and (ii) the anatomy of nasal cavities. These researchers examined the usefulness of AR and RMM, in particular in the surgical field. They listed the normal values for these tests. Nasal obstruction is a symptom of multi-factorial origin. Nasal patency is only one factor influencing the sensation of nasal ventilation. Despite the range of divergent opinions in both the literature and among rhinological clinicians, the objective assessment of nasal patency in functional rhinoplasty or septo-rhinoplasty seems to be advisable. The authors stated that the roles of AR and RMM still have to be established.

de Aguiar Vidigal et al (2013) evaluated the nose of patients with OSA syndrome (OSAS), compared them to controls, and correlated the different methods used to evaluate the nose. A total of 47 patients with moderate-to-severe OSAS and 20 controls who were matched for gender, age, and BMI were included. Questionnaires regarding sleep and nasal
symptoms, physical examination, AR, naso-fibroscopy, rhinoscopy, as well as nasal inspiratory peak flow (NIPF) measurements were performed. In the OSAS group, 33 (70.2 %) were male, with a mean age of 53.2 +/- 9.1 years. In the control group, 13 (65 %) were male, with a mean age of 53.7 +/- 9.7 years. The OSAS group had a higher score on the nasal symptoms scale (p < 0.01) and a higher frequency of nasal alterations [presence of septal deviation, clinical complaints (p = 0.01) and hypertrophy of the inferior nasal turbinate (p < 0.01)]. The NIPF and AR parameters could not differentiate between the OSAS and control groups. There were no significant correlations among the different methods used to evaluate the nose. Lower NIPF values were capable of predicting higher apnea-hypopnea index scores (p = 0.007). The authors concluded that clinical complaints and nasal alterations as measured by rhinoscopy and naso-fibroscopy were associated with the presence of OSAS, which was not the case for the AR and NIPF parameters. The results of different evaluation methods were not correlated with each other.

Mendes et al (2012) correlated objective assessment of nasal obstruction, as measured by AR (volume of the first 5 cm of the nasal cavity) and active anterior RMM (total nasal airway resistance), with its subjective evaluation (obstruction scores). A total of 30 patients, aged 7 to 18 years, with persistent allergic rhinitis and 30 controls were enrolled. The obstruction score was reported for the whole nasal cavity and for each nostril separately. The 3 variables were measured at baseline and after induction of nasal obstruction. There were significant and negative correlations between resistance and nasal volume in all groups and scenarios, except for the most obstructed nostril, in the control group, post-obstruction. For the whole nasal cavity, there was no significant correlation between objective and subjective variables except between score and total nasal cavity volume in the control group, post-obstruction. Regarding the most obstructed nostril, these investigators found a significant negative correlation between
score and resistance and a significant positive correlation between score and volume for the total group at baseline. There were no clear differences in the correlation coefficients found in patients and controls. The correlation coefficients did not change after induction of nasal obstruction. The authors concluded that objective assessment of nasal obstruction did not correlate significantly with subjective evaluation for the nasal cavity as a whole, but there was a correlation for unilateral assessments. There was correlation between the objective evaluations. Allergic rhinitis and acute induction of nasal obstruction did not affect the correlation between objective and subjective assessments of nasal obstruction. Moreover, they stated that addition of an objective method for evaluation of nasal obstruction could be useful in the research setting; if no such method can be used, each nostril should be evaluated separately.

Altuntas et al (2013) noted that Crimean-Congo hemorrhagic fever (CCHF), like other viral infections, may prolong mucociliary clearance time and increase nasal resistance in children. The aim of the present prospective case-control study was to study, using saccharin and anterior RMM tests, whether CCHF infections caused any change in nasal physiology. A total of 40 subjects (20 of whom had CCHF (group 1) and 20 of whom were healthy controls (group 2)), were enrolled in this study. The definitive diagnosis of CCHF infection was made based on typical clinical and epidemiological findings and detection of CCHF virus-specific IgM by ELISA or of genomic segments of the CCHF virus by reverse transcription-polymerase chain reaction. Anterior RMM was performed in all participants according to current recommendations of the Committee Report on Standardization of Rhinomanometry. A saccharin test was used to evaluate mucociliary clearance, and nasal mucociliary clearance time was assessed with the saccharin test as described previously. In these patients, the mean time from the application of saccharin crystals to the first feeling of a sweet taste was 6.77 ± 3.25 minutes (range of 2 to 16 mins). In terms of the mean
time from the application of saccharin crystals to the first feeling of a sweet taste, there was no difference between 2 groups. The mean total air flow was 637.60 ± 76.18 ml/s (range of 490 to 760 ml/s). The mean total nasal airway resistance was 0.24 ± 0.03 Pa/ml/s (range of 0.20 to 0.31 Pa/ml/s). In terms of the degree of nasal air flow and nasal airway resistance and the total air flow and total nasal airway resistance of each nostril, there was no difference between the 2 groups. The authors concluded that the results obtained in anterior RMM and saccharin test showed that there was no statistically significant difference between CCHF (+) patients and controls. These findings suggested that CCHF virus infection does not affect nasal physiology. However, this is the first study performed on this issue and further studies on larger series need to be performed.

Haavisto and Sipila (2013) compared AR, RMM, and subjective estimation of the nasal obstruction before and after septoplasty and evaluated the long-term results of septal surgery. The study included 30 adult patients who were operated on because of septal deviation. Pre-operatively, AR and active anterior RMM were performed on each subject after decongestion of the nose. A visual analog scale (VAS) for unilateral nasal obstruction was filled in by the patients. The measurements were repeated both 6 months and 10 years post-operatively. A significant change in acoustic values was found during the long-term follow-up of 10 years. The mean minimal cross-sectional area on the more obstructive side was 0.35 cm(2) pre-operatively. Six months after operation, it was 0.52 cm(2), and 10 years after operation, it was 0.68 cm(2). The mean resistance fell from pre-operative 1.16 Pa/ml/s to 0.41 Pa/ml/s during the first 6 months, but rose again to 1.21 Pa/ml/s after 10 years. Despite a tendency of improvement, no statistically significant change was found between pre-operative and post-operative values in VAS. Six months after operation, 69 % of the patients were satisfied with the result, and after 10 years the amount of satisfied patients was 83 %. The authors found an increase in acoustic values, but an
increase in nasal resistance in the long-term follow-up. Other factors than nasal area may have an impact on nasal resistance and the feeling of nasal obstruction. The small size on the sample interfered with the results.

Lambert et al (2013) noted that patients with non-allergic irritant rhinitis (NAIR) have symptoms of nasal congestion, nasal irritation, rhinorrhea, and sneezing in response to nasal irritants. There is currently no reliable objective means to quantify these patients' subjective symptoms. In this study, these researchers used the transient receptor potential vanilloid receptor (TRPV1) receptor agonist, capsaicin, as an intra-nasal challenge while comparing the changes in blood flow with optical rhinometry between subjects with NAIR and healthy controls (HCs). A total of 6 HCs and 6 NAIR subjects were challenged intra-nasally with saline solution followed by increasing concentrations of capsaicin (0.005 mM, 0.05 mM, and 0.5 mM) at 15-min intervals. These investigators recorded maximum optical density (OD) and numeric analog scores (NAS) for nasal congestion, nasal irritation, rhinorrhea, and sneezing for each subject after each challenge. Correlations between NAS and maximum OD were calculated. Maximum OD increased with increasing concentrations of intra-nasal capsaicin in NAIR subjects. There were significant differences in maximum OD obtained for 0.05 mM and 0.5 mM capsaicin between NAIR subjects and HCs. Significant differences were found in the NAS for nasal irritation at 0.005 mM, 0.05 mM, and 0.5 mM, and nasal congestion at 0.5 mM. Correlation between maximum OD and mean NAS was most significant for 0.05 mM capsaicin. The authors concluded that optical rhinometry with intra-nasal capsaicin challenge could prove a viable option in the diagnosis of NAIR. Moreover, they stated that further studies will investigate its use to monitor a patient's response to pharmacologic therapy and provide further information about the underlying mechanisms of NAIR. The findings of this small study need to be validated by well-designed studies.
Also, an UpToDate review on “Clinical presentation, diagnosis, and treatment of nasal obstruction” (Bhattacharyya, 2013) states that “Several other tests can be performed to help characterize nasal obstruction. The data supporting the use of these measurements are somewhat controversial and results can be less than definitive .... The degree of nasal obstruction, as measured objectively by acoustic rhinometry, peak nasal airflow, or rhinomanometry, may not correlate well with the patient’s subjective sense of nasal obstruction. As an example, minimal changes in nasal patency (measured objectively) may still manifest as a significant symptomatic problem in the individual patient”.

In a prospective study, Toros et al (2013) evaluated the differences in acoustic rhinometric findings between the affected and non-affected sides in patients with unilateral chronic otitis media (COM) and examined if unilateral COM correlates with the side of nasal obstruction. A total of 55 consecutive patients with unilateral COM were involved in this study. All patients were evaluated with AR, the Nasal Obstruction Symptom Evaluation (NOSE) scale, and measurement of their nasal muco-ciliary transport time. The mean cross-sectional area 1, mean cross-sectional area 2, volume 1, and volume 2 values were not different between the affected and non-affected sides (p > 0.05). The NOSE score had a reverse correlation with the mean cross-sectional area 2 (p < 0.05) and volume 2 (p < 0.01) of the affected side. Saccharin time was not correlated with the acoustic rhinometric values of the affected side (p > 0.05). The authors concluded that these findings did not support the hypothesis that unilateral COM is correlated with the side of nasal obstruction.

In a prospective study, Dadgarnia and colleagues (2013) used the objective parameters of AR and rhinomanometry to evaluate the effectiveness of septoplasty surgery. A total of 30 patients for septoplasty surgery were enrolled in this study; AR and rhinomanometry tests were performed on all patients both
before and 3 months following the operation. The symptom recovery rate was recorded according to the patient's statements and anterior rhinoscopic examinations 3 months post-surgery. Data were analyzed using a t-test and chi-square tests in an SPSS package. A total of 26 of 30 patients returned for a post-surgery follow-up examination after 3 months. Patients were aged from 18 to 32 years (average of 25 years). In total, 69.2% (18 patients) were satisfied with the results of the procedure. In addition, rhinomanometry resulted in a decrease in general nasal resistance if patients used decongestants ($p = 0.03$). However, the decrease was not significant before the use of decongestants ($p = 0.12$).

Furthermore, according to the results from AR, there was an increase in the nasal cross-sectional area on both the narrow and wide sides after the operation ($p < 0.05$), although this increase was not so notable in the narrower side after using decongestants. There was, however, no significant relationship between the results from the objective tests and the patient's symptoms or clinical examinations ($p > 0.05$). The authors concluded that these findings showed that although the objective tests confirm an improvement in general nasal resistance and an increase in the nasal cross-sectional area after surgery, no unambiguous relationship between the patient's symptoms and the clinical examinations was observed. Therefore, such objective tests did not prove to be sufficient diagnostic criteria for the effectiveness of septoplasty.

Patuzzi and Cook (2014) described a simple and inexpensive method for monitoring nasal air flow resistance using measurement of the small-signal acoustic input impedance of the nasal passage, similar to the audiological measurement of ear drum compliance with acoustic tympanometry. The method requires generation of a fixed sinusoidal volume-velocity stimulus using ear-bud speakers, and an electret microphone to monitor the resultant pressure fluctuation in the nasal passage. Both are coupled to the nose via high impedance silastic tubing and a small plastic nose insert. The
acoustic impedance is monitored in real-time using a laptop soundcard and custom-written software developed in LabView 7.0 (National Instruments). The compact, lightweight equipment and fast time resolution lends the technique to research into the small and rapid reflexive changes in nasal resistance caused by environmental and local neurological influences. The authors concluded that the acoustic impedance rhinometry technique has the potential to be developed for use in a clinical setting, where the need exists for a simple and inexpensive objective nasal resistance measurement technique.

Lange et al (2014) stated that chronic rhino-sinusitis (CRS) is a disease related to the nose and the para-nasal sinus as defined by the European Position Paper on Rhinosinusitis and Nasal Polyps (EPOS) criteria. The criteria include subjective symptoms, such as nasal obstruction, and objective findings by endoscopy. Acoustic rhinometry is an objective method to determine nasal cavity geometry. The technique is based on a sound pulse reflection analysis in the nasal cavity and determines cross-sectional areas as a function of distance as well as volume. Acoustic rhinometric measurements in persons recruited from the general population, with and without CRS based on the clinical EPOS criteria, were investigated. As part of a trans-European study, a total of 362 persons, comprising 91 persons with CRS and 271 persons without CRS, were examined by an otolaryngologist including rhinoscopy. Minimum cross-sectional area, distance to minimum cross-sectional area, and volume in the nasal cavity were measured by AR and all participants underwent PNIF and allergy test. A difference in AR was found before and after decongestion, but no difference was seen between CRS patients and controls. Positive correlation between AR and PNIF was found and AR was capable of identifying mucosal edema and septum deviation visualized by rhinoscopy. The authors concluded that AR, as a single instrument, was not capable of discriminating persons with CRS from persons without CRS in the general population.
Brockmann et al (2013) examined the diagnostic test accuracy (DTA) of different tests for OSA compared to polysomnography (PSG) in children. These investigators performed a systematic review according to DTA criteria published by the Cochrane Collaboration. Studies that compared any possible diagnostic test with PSG for diagnosing OSA were considered. Study quality assessment was conducted in each selected study and DTA measures recalculated by hand whenever possible. Excellent DTA was defined as positive likelihood ratio (PLR) greater than 10 and negative likelihood ratio (NLR) less than 0.1. These researchers identified 1,064 potentially relevant studies, of which 33 met inclusion criteria. Study quality was generally low; 5 studies fulfilled all quality criteria and 11 studies included more than 100 subjects. Included studies compared 40 different tests to PSG. Only 13 studies used the currently accepted definition for OSA (i.e., AHI greater than or equal to 1). In these studies, PLR ranged from 1.017 to infinity, NLR from 0 to 1.089. Sleep lab-based polygraphy, urinary biomarkers, and rhinomanometry (1 study each) showed excellent DTA. The authors concluded that there is limited evidence concerning diagnostic alternatives to PSG for identifying OSA in children. However, polygraphy, urinary biomarkers, and rhinomanometry may be valid tests if their apparently high DTA is confirmed by subsequent studies.

Aziz et al (2014) performed a systematic review of measurement tools utilized for the diagnosis of nasal septal deviation (NSD). Electronic database searches were performed using MEDLINE (from 1966 to 2nd week of August 2013), EMBASE (from 1966 to 2nd week of August 2013), Web of Science (from 1945 to 2nd week of August 2013) and all Evidence Based Medicine Reviews Files (EBMR); Cochrane Database of Systematic Review (CDSR), Cochrane Central Register of Controlled Trials (CCTR), Cochrane Methodology Register (CMR), Database of Abstracts of Reviews of Effects (DARE), American College of Physicians Journal Club (ACP Journal Club), Health Technology...
Assessments (HTA), NHS Economic Evaluation Database (NHSEED) till the 2nd quarter of 2013. The search terms used in database searches were 'nasal septum', 'deviation', 'diagnosis', 'nose deformities' and 'nose malformation'. The studies were reviewed using the updated Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool. Online searches resulted in 23 abstracts after removal of duplicates that resulted from overlap of studies between the electronic databases. An additional 15 abstracts were excluded due to lack of relevance. A total of 8 studies were systematically reviewed. The authors concluded that diagnostic modalities such as acoustic rhinometry, rhinomanometry and nasal spectral sound analysis may be useful in identifying NSD in anterior region of the nasal cavity, but these tests in isolation are of limited utility. They stated that compared to anterior rhinoscopy, nasal endoscopy, and imaging the above mentioned index tests lack sensitivity and specificity in identifying the presence, location, and severity of NSD.

Yuksel (2014) investigated the effects of anterior rhinomanometry-induced nasal resistance on OSAS patients. Between May 2011 and September 2011, a total of 100 patients (76 males, 24 females; mean age of 47.6 ± 11.6 years; range of 20 to 71 years) who were admitted with complaints of snore, breathing pauses told by their partners, oversleep mood in a daytime and fatigue and diagnosed with OSAS by PSG with simple snore were included. Anterior rhinomanometry was applied for all patients and nasal resistance was estimated. Mallampati index and BMI of patients was calculated. The mean AHI and minimum oxygen saturation values were measured. There was no significant relationship between nasal resistance and AHI. However, a significant relationship between AHI and Mallampati and BMI values was observed. The AHI values increased, as the Mallampati and BMI values increased. The authors concluded that these findings showed that nasal resistance has no significant effect on AHI and minimum oxygen saturation in OSAS patients.
Major et al (2014) conducted a systematic review to examine the accuracy of alternative tests compared with nasoendoscopy (reference standard) for screening adenoid hypertrophy. The review included searches of electronic databases, hand-searches of bibliographies of relevant articles and gray literature searches. They included all articles in which an alternative test was compared with nasoendoscopy in children with suspected nasal or nasopharyngeal airway obstruction. These researchers identified 7 articles that were of poor to good quality. They identified the following alternative tests: multi-row detector computed tomography (sensitivity, 92 %; specificity, 97 %), videofluoroscopy (sensitivity, 100 %; specificity, 90 %), rhinomanometry with decongestant (sensitivity, 83 %; specificity, 83 %) and clinical examination (sensitivity, 22 %; specificity, 88 %). Lateral cephalograms tended to have good to fair sensitivity (typically 61 to 75 % and poor specificity (41 to 55 %) when adenoid size was evaluated but excellent to good specificity when airway patency was evaluated (68 to 96 %). The authors concluded that no ideal tool exists for dentists to screen adenoid hypertrophy, owing to access constraints, radiation concerns and suboptimal diagnostic accuracy. They stated that research is needed to identify a low-risk, easily acceptable, highly valid diagnostic screening tool.

Melo et al (2015) noted that when there is a change in the physiological pattern of nasal breathing, mouth breathing may already be present. The diagnosis of mouth breathing is related to nasal patency. One way to access nasal patency is by AR. These investigators systematically reviewed the effectiveness of AR for the diagnosis of patients with mouth breathing. Electronic databases LILACS, MEDLINE via PubMed and Bireme, SciELO, Web of Science, Scopus, PsycInfo, CINAHL, and Science Direct, from August to December 2013, were consulted. A total of 11,439 articles were found: 30 from LILACS, 54 from MEDLINE via Bireme, 5,558 from MEDLINE via PubMed, 11 from SciELO, 2,056 from Web of Science, 1,734 from Scopus, 13 from PsycInfo,
1,108 from CINAHL, and 875 from Science Direct. Of these, 2 articles were selected. The heterogeneity in the use of equipment and materials for the assessment of respiratory mode in these studies revealed that there is not yet consensus in the assessment and diagnosis of patients with mouth breathing. The authors concluded that according to the articles, AR has been used for almost 20 years, but controlled studies attesting to the effectiveness of measuring the geometry of nasal cavities for complementary diagnosis of respiratory mode are warranted.

In a prospective clinical study, Salgueiro et al (2015) analyzed the velopharyngeal (VP) activity of subjects with velopharyngeal dysfunction (VPD) by AR, as compared to rhinomanometry. A total of 41 adults, both genders, with repaired cleft palate, with or without a previously repaired cleft lip, and residual VPD on clinical assessment, without compensatory articulations for [p], [t], and [k] were included in this study. The outcome measures were as follows: (i) on AR, nasopharyngeal volumetric change (ΔV) during [p], [t], and [k], relatively to rest condition (decreases by less than 3 cm³ considered as absence of VP activity); (ii) on modified anterior rhinomanometry, VP orifice area (areas greater than or equal to 0.05 cm² considered as inadequate closure). The plosive [p] was used when comparing the techniques (n = 24). A mean ΔV decrease of 18 % was observed during [k], which was significantly lower (p < 0.05) than the decrease reported for individuals without VPD (30 %); ΔV values suggesting VPD were observed in 59 % subjects. Similar results were obtained for [p] and [t], which shall be used as stimulus, given that they did not involve the use of the tongue to lift the velum during VP closure, differently from the velar plosive [k]. Inadequate closure was seen in 85 % subjects. No correlation was observed between ΔV and VP orifice area. Agreement between techniques was observed in 51 % cases. The authors concluded that AR had low accuracy as a diagnostic method of VPD when compared to the gold
standard method. Nevertheless, the technique showed potential as a method for monitoring the outcomes of clinical and surgical treatment of VPD aimed at increasing velar and pharyngeal activity.

In a retrospective, individual cohort study, Hsu and colleagues (2016) evaluated the effectiveness of septoplasty and the correlation between the subjective evaluations of a VAS and the NOSE questionnaire and active anterior rhinomanometry of the nasal airway after septoplasty. A total of 50 patients with chronic nasal obstruction were enrolled in the study. All 50 patients underwent septoplasty because of nasal septal deviation. Another 28 patients without nasal symptoms served as controls; VAS, NOSE, and active anterior rhinomanometry were used to measure the sensation of nasal obstruction. All measurements were performed in both groups pre-operatively and then repeated on 3 post-operative visits (3, 6, and 12 months). The mean VAS score, NOSE score, and the nasal resistance in the narrow side of the nose in the study group showed reduced symptoms at 3, 6, and 12 months post-operatively compared with the respective pre-operative measurements (p < 0.001, all). The VAS and NOSE scores did not significantly correlate with total nasal resistance pre-operatively or post-operatively. The VAS and nasal resistance in the obstructed nasal cavity correlated significantly pre-operatively (p < 0.05) but not post-operatively. The authors concluded that the subjective and objective symptoms of nasal obstruction had improved 1 year after septoplasty. A significant correlation between VAS scores and nasal resistance in the narrow side of the nose was found before surgery. However, the subjective and objective measurements of nasal obstruction lacked significant correlation post-operatively.

Fedok and colleagues (2016) stated that the middle vault of the nose continues to be a topic of interest among surgeons interested in aesthetic and functional rhinoplasty. These investigators presented currently accepted concepts regarding
the significance of the middle vault of the nose in rhinoplasty and reviewed the more frequently advocated methods to be used in the correction of deficiencies. Spreader grafts may be at least as effective as flaring sutures in improving the airway. Studies have shown an improvement in quality of life and nasal breathing with the use of auto-spreader flaps. The correlation between AR and clinical symptoms of nasal obstruction, however, has fallen short of providing clear diagnostic value. The diagnosis of middle vault collapse and nasal valve obstruction remains largely clinical. The patient's reported symptoms of nasal obstruction were diagnostically considered along with the findings of clinical examination, including the findings of a modified Cottle maneuver. The use of spreader grafts and auto-spreader flaps has been popularized to correct problems in the middle vault of the nose and will be presented in detail in this manuscript.

Krzych-Falta and Samolinski (2016) noted that optical rhinometry is the only diagnostic tool in rhinitis for assessing real-time changes in nasal occlusion. It illustrates lumen changes of nasal mucosa vessels in response non-specific/specific factors and not only. The first attempts to standardize the method conducted by German researchers showed the potential of optical rhinometry not only as regards challenge tests, but also vice versa, in respect of the anemization of the mucosa it evaluates the extent of the edema that occurred in the patho-mechanism of non-allergic rhinitis. The authors concluded that the relatively small number of publications in the domain of interest demonstrated there is a need to conduct further research on the suitability of the above-mentioned technique for the evaluation of nasal patency in the field of rhinological diagnostics.

Umihanic and co-workers (2016) noted that surgical and medical treatments of nasal obstruction are a common parts of otolaryngologist practice. The definitive treatment of deviated nasal septum is septoplasty. These investigators evaluated the values of subjective parameters, and active anterior
rhinomanometry (AAR) parameters prior and 3 months after the septoplasty. They analyzed the subjective parameters ("NOSE" scale), the AAR parameters according to International Committee on Standardization of Rhinomanometry, on 40 patients; 30 healthy adult volunteers served as controls. None of the patients or healthy volunteers had previous history of nasal surgery or active rhinological disease. The post-operative improvement in symptoms of nasal obstruction obtained in 92.5% patients and improvement parameters of the AAR in 42.5% patients. The authors concluded that the correlation between the findings with rhinomanometry and subjective sensation of nasal patency remains uncertain. There still appeared to be only a limited argument for the use of rhinomanometry for quantifying surgical results. They stated that 3 months post-operative findings were very early results to interpret the permanent effects.

Chen and colleagues (2016) clarified the relationship between rhinomanometry measurements, fractional exhaled nitric oxide (FeNO), and spirometric measurements in asthmatic children. Patients' inclusion criteria: were age between 5 and 18 years, history of asthma with nasal symptoms, and no anatomical deformities. All subjects underwent rhinomanometric evaluations and pulmonary function and FeNO tests. A total of 84 children were enrolled. By rhinomanometry, the degree of nasal obstruction was characterized as follows: (i) no obstruction in 33 children, (ii) slight obstruction in 29 children, and (iii) moderate obstruction in 22 children; FeNO was significantly lower in patients without obstruction than those with slight or moderate obstruction. Dividing patients according to ATS Clinical Practice Guidelines regarding FeNO, patients less than 12 years with FeNO greater than 20 ppb had a lower total nasal airflow rate than those with FeNO less than 20 ppb. Patients greater than or equal to 12 years with FeNO greater than 25 ppb had a lower total nasal airflow rate than those with FeNO less than 25 ppb. The authors concluded that higher FeNO was associated with a lower
nasal airflow and higher nasal resistance. They noted that these findings supported a relationship between upper and lower airway inflammation, as assessed by rhinomanometry and FeNO; and the results suggested that rhinomanometry may be integrated as part of the functional assessment of asthma. The authors stated that the present study provided preliminary results regarding the relationship between the upper and lower airways. As abnormalities in nasal patency are often associated with respiratory symptoms in pediatric patients, information on the degree of nasal patency is therefore useful in selecting decongestive, anti-allergic, anti-infectious, anti-inflammatory, and other therapies, and may help in the management of asthmatic children.

The main drawback of this study was the number of cases, which was simply too small to determine the full spectrum of relationships among these parameters. Larger numbers of cases in prospective, randomized studies are needed to determine relationships between rhinomanometric and spirometric measurements, IgE, allergic rhinitis symptom scores, and FeNO.

Sakai and associates (2016) stated that to provide clinical information and diagnosis in mouth breathers with transverse maxillary deficiency with posterior cross-bite, numerous examinations can be performed; but the correlation among these examinations remains unclear. In a cross-sectional study, these researchers evaluated the correlation between AR, computed rhinomanometry, and cone-beam CT in mouth breathers with transverse maxillary deficiency. This study was conducted in 30 mouth breathers with transverse maxillary deficiency (age of 7 to 13 years) patients with posterior cross-bite. The examinations assessed: (i) AR: nasal volumes (0 to 5 cm and 2 to 5 cm) and minimum cross-sectional areas 1 and 2 of nasal cavity; (ii) computed rhinomanometry: flow and average inspiratory and expiratory resistance; and (iii) cone-beam CT: coronal section on the head of inferior turbinate (widths 1 and 2), middle turbinate (widths 3 and 4) and maxilla.
levels (width 5); AR and computed rhinomanometry were evaluated before and after administration of vasoconstrictor. Results were compared by Spearman's correlation and Mann-Whitney tests (α = 0.05). Positive correlation was observed between: (i) flow evaluated before administration of vasoconstrictor and width 4 (Rho = 0.380) and width 5 (Rho = 0.371); (ii) width 2 and minimum cross-sectional areas 1 evaluated before administration of vasoconstrictor (Rho = 0.380); (iii) flow evaluated before administration of vasoconstrictor and nasal volumes of 0 to 5 cm (Rho = 0.421), nasal volumes of 2 to 5 cm (Rho = 0.393) and minimum cross-sectional areas 1 (Rho = 0.375); (iv) width 4 and nasal volumes of 0 to 5 cm evaluated before administration of vasoconstrictor (Rho = 0.376), nasal volumes of 2 to 5 cm evaluated before administration of vasoconstrictor (Rho = 0.376), minimum cross-sectional areas 1 evaluated before administration of vasoconstrictor (Rho = 0.410) and minimum cross-sectional areas 1 after administration of vasoconstrictor (Rho = 0.426); (v) width 5 and width 1 (Rho = 0.542), width 2 (Rho = 0.411), and width 4 (Rho = 0.429). Negative correlation was observed between: (i) width 4 and average inspiratory resistance (Rho = -0.385); (ii) average inspiratory resistance evaluated before administration of vasoconstrictor and nasal volumes of 0 to 5 cm (Rho = -0.382), and average expiratory resistance evaluated before administration of vasoconstrictor and minimum cross-sectional areas 1 (Rho = -0.362). The authors concluded that there was correlation between AR, computed rhinomanometry, and cone-beam CT in mouth breathers with transverse maxillary deficiency.

These investigators stated that the findings of this study have a special relevance for future research challenges. They noted that in the future, comprehensive studies should be carried out with larger sample sizes and include comparisons between the groups mentioned in the drawbacks of this study, as well as the results obtained from the long-term treatment of transverse maxillary deficiency with maxillary expansion.
The drawbacks of this study included: (i) small sample size ($n = 30$), (ii) non-inclusion of healthy controls for correlation between the tests, and (iii) non-inclusion of controls with deficiency and nasal breathers. Controls were not included due to the need of cone-beam CT examinations.

Shohara and colleagues (2017) stated that numerous techniques have been used to reduce epistaxis during naso-tracheal intubation. Rhinometry can assess nasal patency in pre-operative conditions. However, the possible role of rhinometry in routine naso-tracheal intubation has not been studied. In this study, a total of 101 patients undergoing dental and maxilla-facial surgery that required general anesthesia and naso-tracheal intubation were enrolled. These researchers examined if symmetry or any asymmetry in bilateral airflow patterns by condensation of the expiration, assessed by pre-operative rhinometry on seated position, increased the incidence of epistaxis and the need for a naso-gastric catheter to guide the endo-tracheal tube into the oropharynx. They also compared the incidence of changing the site of nasal intubation between the assessment by rhinometry and by cone-beam CT analysis of nasal airspace in the inferior meatus. Patients with any asymmetry in bilateral airflow patterns were 18% ($n = 18$), the remaining 82% ($n = 83$) had symmetric bilateral nasal cavities. Patients with any asymmetry were more likely to need a guiding naso-gastric catheter than patients with symmetry (22% versus 3.6%, $p = 0.018$). The incidence of epistaxis was higher in patients with any asymmetry (39%) than those with symmetry (16%), but there was no significant difference between groups ($p = 0.055$). The site of intubation was changed more frequently based on cone-beam CT analysis than by rhinometry (38% versus 11%, $p = 0.043$). The authors concluded that pre-operative rhinometry may be a valuable objective tool to evaluate nasal patency for naso-tracheal intubation in patients who undergo dental and maxilla-facial surgery.
Bock and colleagues (2017) stated that cystic fibrosis (CF) patients almost regularly reveal sinonasal pathology. These researchers evaluated association between objective and subjective measurements of sinonasal involvement comparing nasal airflow obtained by AAR, nasal endoscopic findings, and symptoms assessed with the Sino-Nasal Outcome Test-20 (SNOT-20). Nasal cavities were explored by anterior rigid rhinoscopy and findings were compared to inspiratory nasal airflow measured by AAR to quantify nasal patency and subjective health-related quality of life (QOL) in sinonasal disease obtained with the SNOT-20 questionnaire. Relations to upper and lower airway colonization with Pseudomonas aeruginosa, medical treatment, and sinonasal surgery were analyzed. A total of 124 CF patients were enrolled (mean age of 19.9 ± 10.4 years, range of 4 to 65 years). A significant association of detection of nasal polyposis (NP) in rhinoscopy was found with increased primary nasal symptoms (PNS), which include "nasal obstruction", "sneezing", "runny nose", "thick nasal discharge", and "reduced sense of smell". At the same time patients with pathologically decreased airflow neither showed elevated SNOT-20 scores nor abnormal rhinoscopic findings. Altogether, rhinomanometric and rhinoscopic findings were not significantly related. The authors concluded that among SNOT-20 scores the PNS subscore was related to rhinoscopically detected polyposis and sinonasal secretion. Thus, these investigators recommend including short questions regarding PNS into CF-routine care. At the same time these findings showed that a high inspiratory airflow was not associated with a good sensation of nasal patency. They stated that rhinomanometry is not needed within routine CF-care, but it can be interesting as an outcome parameter within clinical trials.

CPT Codes / HCPCS Codes / ICD-10 Codes

*Information in the [brackets] below has been added for clarification purposes. Codes requiring a 7th character are represented by "+":*
<table>
<thead>
<tr>
<th>Code</th>
<th>Code Description</th>
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<tbody>
<tr>
<td><strong>ICD-10 codes will become effective as of October 1, 2015:</strong></td>
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<tr>
<td>CPT codes not covered for indications listed in the CPB:</td>
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<tr>
<td>92512</td>
<td>Nasal function studies (e.g., rhinomanometry)</td>
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<tr>
<td>Other CPT codes related to the CPB:</td>
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<tr>
<td>31231 - 31235</td>
<td>Nasal and nasal/sinus, diagnostic, endoscopy</td>
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<tr>
<td>70450 - 70470</td>
<td>Computed tomography, head or brain</td>
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<tr>
<td>ICD-10 codes not covered for indications listed in the CPB:</td>
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<tr>
<td>J01.00 - J01.91</td>
<td>Acute sinusitis</td>
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<tr>
<td>J30.1 - J30.9</td>
<td>Vasomotor and allergic rhinitis</td>
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<tr>
<td>J32.0 - J32.9</td>
<td>Chronic sinusitis</td>
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<tr>
<td>J34.2</td>
<td>Deviated nasal septum</td>
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<tr>
<td>J34.3</td>
<td>Hypertrophy of nasal turbinates</td>
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The above policy is based on the following references:


12. Austin CE, Foreman JC. Acoustic rhinometry compared with posterior rhinomanometry in the measurement of


41. Bhattacharyya N. Clinical presentation, diagnosis, and treatment of nasal obstruction. UpToDate [online.
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(June 2015)


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Amendment to Aetna Clinical Policy Bulletin Number: 0700 Rhinometry and Rhinomanometry

There are no amendments for Medicaid.