

Scoring systems for allergies and asthma in clinical research and practice

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ABSTRACT

Background: Scoring systems are increasingly being developed for various diseases, including asthma and allergic disorders, with the objective of improving the classification of disease severity and the assessment of efficacy of therapeutic modalities.

Objective: This review provided concise summaries of published scoring systems used for allergic rhinitis, asthma, atopic dermatitis, urticaria, Stevens-Johnson syndrome/toxic epidermal necrolysis, eosinophilic esophagitis, and systemic allergic reactions (anaphylaxis).

Methods: We searched the medical literature between 1985 and 2018 for published scoring systems that have been developed and used in clinical trials or in practice for assessment of asthma and a variety of allergic disorders.

Results: The scoring systems for each of these diseases were briefly presented in the text in chronological order of publication, and selected information was presented in the tables for easy comparisons. For more details, the reader should refer to the original relevant publications.

Conclusion: Such assessment methods are useful for sound designing of clinical trials, fair comparisons of findings of studies, and objective measurements of patients' progress in clinical practice. The choice of using one scoring system over another would depend on its proven degree of validity, the purpose, and applicability.

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Assessment of disease severity or response to therapy has been moving more toward using objective parameters and less dependence on subjective impressions. Whereas quantitative variables are accurately measured, qualitative variables have been assessed by developing scoring systems. We searched the medical literature in English between 1985 and 2018 for published clinical scoring systems used for assessment of asthma and hypersensitivity disorders. These scoring systems are briefly summarized, in chronological order, complemented with tables and relevant references for more details. They should be useful for sound design of clinical trials, when comparing the findings of studies, and when monitoring the progress of individual patients.

ALLERGIC RHINITIS

Allergic rhinitis scoring systems are summarized in Table 1.

Rhinoconjunctivitis Quality of Life Questionnaire

The original Rhinoconjunctivitis Quality of Life Questionnaire (RQLQ) was first published in 1991 by

Juniper and Guyatt.¹ The questionnaire has patients identify areas of their lives that are affected by rhinoconjunctivitis. RQLQ is intended as a measure of health-related quality of life in clinical trials¹ in both rhinoconjunctivitis and rhinitis. Validity was tested in a randomized, double-blind trial of beclomethasone nasal spray regularly used versus “as required” in ragweed pollen-induced rhinoconjunctivitis. The RQLQ contains 28 questions related to local symptoms, systemic symptoms, sleep disturbance, practical problems, activity limitations, and emotional problems.¹ Both the original and a standardized version can be obtained from the investigators.²

Mini-Rhinoconjunctivitis Quality of Life Questionnaire

Published in 2000, the Mini-Rhinoconjunctivitis Quality of Life Questionnaire (MiniRQLQ) was derived from the original RQLQ by combining items with high item-item correlations and then selecting the highest scoring items for the MiniRQLQ.³ The MiniRQLQ has 14 questions and was developed to be more efficient than the 28-item RQLQ. It can be obtained with permission from the investigators.²

Allergic Rhinitis and Its Impact on Asthma Group Classification

In 2001, Bousquet *et al.*⁴ developed the Allergic Rhinitis and Its Impact on Asthma (ARIA) group, and, in collaboration with the World Health Organization, published

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Table 1 Allergic rhinitis scoring systems

Scoring System	Study, y	Intended Use	No. Items
RQLQ	Juniper and Guyatt, ¹ 1991	Measure health-related quality of life in clinical trials	28
Mini-RQLQ	Juniper <i>et al.</i> , ³ 2000	Measure health-related quality of life in clinical trials	14
ARIA	Bousquet <i>et al.</i> , ⁴ 2001	Classification to aid management, not meant to be quantitative	5
CARAT	Nogueira-Silva <i>et al.</i> , ⁹ 2009	Measure control of both asthma and allergic rhinitis to guide management	17
CARAT10	Fonseca <i>et al.</i> , ¹⁰ 2010	Measure control of both asthma and allergic rhinitis by using fewer questions to guide management	10
CARATkids	Borrego <i>et al.</i> , ¹¹ 2014	Measure control of asthma and allergic rhinitis in children ages 6–12 y	17
RCAT	Nathan <i>et al.</i> , ¹⁵ 2010	Help patients and providers detect problems with rhinitis symptom control	6
ARCT	Demoly <i>et al.</i> , ¹⁷ 2011	Categorize rhinitis as poorly or well controlled to guide pharmacotherapy	5

RQLQ = Rhinoconjunctivitis Quality of Life Questionnaire; ARIA = Allergic Rhinitis and its Impact on Asthma; CARAT = Control of Allergic Rhinitis and Asthma Test; CARAT10 = CARAT with 10 questions; CARATkids = CARAT, pediatric version; RCAT = Rhinitis Control Assessment Test; ARCT = Allergic Rhinitis Control Test.

guidelines on the classification and management of allergic rhinitis. The investigators indicated that allergic rhinitis should be classified by duration and severity. Duration is divided into “intermittent” (<4 days/wk or for <4 weeks) or “persistent” (>4 days/wk or for >4 weeks).⁴ Severity is “mild” or “moderate-severe,” based on whether any of the following are present: sleep disturbance; impairment of daily activities, leisure, sport; impairment of school and/or work; or troublesome symptoms. “Mild” allergic rhinitis presents none of the previous impairments.⁴ This classification was maintained in the ARIA 2008 update.⁵ The investigators also observed that other measures can be clinically useful, such as the RQLQ and visual analog scales.⁴ Visual analog scales have been published by the Joint Task Force on Practice Parameters.^{6,7} The ARIA system has been quantified into a score of 0–4 and compared with quality-of-life measures.⁸

Control of Allergic Rhinitis and Asthma Test

A tool to measure control of both upper and lower airway diseases was published in 2009 as the Control of Allergic Rhinitis and Asthma Test (CARAT).⁹ A consensus development process that involves experts and patients led to the development of 17 questions. This was subsequently reduced to 10 questions and two factors, CARAT10,¹⁰ and was validated by comparing with other measures of control as well as physicians’ decisions to adjust treatment. A pediatric version, CARATkids,¹¹ to be used for children ages 6–12

years was subsequently developed and validated with patients in Portugal,¹² the Netherlands,¹³ and Brazil.¹⁴

Rhinitis Control Assessment Test

The Rhinitis Control Assessment Test (RCAT) assists patients and providers in the detection of problems with rhinitis symptom control. It was developed in 2010 through a literature review and patient focus groups were used to draft an instrument with 26 items that assess “five constructs of rhinitis symptom control: frequency and bothersomeness of nasal and non-nasal symptoms, symptom impact, activity interference, symptom control, and medication use. A five-point Likert response scale and a 1-week recall period for each item were adopted based on patient input.”¹⁵ The RCAT was then further refined by identifying 6 items from the original 26 (frequency of nasal congestion, sneezing, and watery eyes; sleep interference; activity avoidance; and self-assessed control) that were most predictive of the allergist’s global rating of rhinitis symptom control.¹⁶

Allergic Rhinitis Control Test

In 2011, the Allergic Rhinitis Control Test (ARCT) was described as a validated self-assessment global score that contained five items to assess rhinitis over the previous 2 weeks.¹⁷ The patient assesses allergic rhinitis regarding the effect on work and/or personal

Table 2 Asthma scoring systems

Scoring System	Study, y	Intended Use	Number of Items
GINA: symptom control	2018 GINA Report ²⁰	Assess whether asthma is well controlled, partly controlled, or uncontrolled to guide management	4
GINA: risk factors for poor outcomes	2018 GINA Report ²⁰	Assess risk factors for poor asthma outcomes to guide management	20
AQLQ	Juniper <i>et al.</i> , ²² 1992	Assess QOL in adults in clinical trials for asthma interventions	32
MiniAQLQ	Juniper <i>et al.</i> , ²⁴ 1999	Assess QOL in clinical trials with more efficiency	15
ACQ	Juniper <i>et al.</i> , ²⁶ 1999	Assess asthma control to guide management	7
ATAQ	Vollmer <i>et al.</i> , ²⁷ 1999	Population-based disease management; identify patients with suboptimal control	4
ATAQ for children and adolescents	Skinner <i>et al.</i> , ²⁸ 2004	Identify children at risk for adverse outcomes of asthma	20
LASS	Lara <i>et al.</i> , ²⁹ 2000	Assess asthma control in both English and Spanish speakers	8
ACT	Nathan <i>et al.</i> , ³¹ 2004	Assess asthma control in clinic practice with limited time and resources, with or without lung function testing	5
PACT	Zorc <i>et al.</i> , ³² 2006	Efficiently assess control of asthma symptoms in children at health care visits	10
ACSS	LeBlanc <i>et al.</i> , ³³ 2007	Quantify asthma control based on criteria proposed by the Canadian Asthma Consensus Guidelines by using subjective symptoms, spirometry data, and sputum eosinophilia	8
CARAT	Nogueira-Silva <i>et al.</i> , ⁹ 2009	Measure control of both asthma and allergic rhinitis to guide management	17
CARAT10	Fonseca <i>et al.</i> , ¹⁰ 2010	Measure control of both asthma and allergic rhinitis to guide management	10
CARATkids	Borrego <i>et al.</i> , ¹¹ 2014	Measure control of asthma and allergic rhinitis in children ages 6–12 y	17

GINA = Global Initiative for Asthma; AQLQ = Asthma Quality of Life Questionnaire; QOL = quality of life; ACQ = Asthma Control Questionnaire; ATAQ = Asthma Therapy Assessment Questionnaire; LASS = Lara Asthma Symptom Scale; ACT = Asthma Control Test; PACT = Pediatric Asthma Control Test; ACSS = Asthma Control Scoring System; CARAT = Control of Allergic Rhinitis and Asthma Test; CARAT10 = CARAT with 10 questions; CARATkids = CARAT, pediatric version.

activities, irritability, sleep disturbance, and need for additional treatment as well as overall; the score is used to categorize rhinitis as poorly or well controlled.¹⁷ The ARCT has recently been further validated as a tool to guide stepwise pharmacotherapy.^{18,19}

ASTHMA

Asthma scoring systems are summarized in Table 2.

Global Initiative for Asthma guidelines

In 1993, the United States National Heart, Lung, and Blood Institute collaborated with the World Health Organization in preparing a Global Strategy for Asthma Management and Prevention. The Global Initiative for Asthma (GINA) guidelines²⁰ were thus established and has published an annual report since 2002. GINA guidelines recommend assessing asthma control with four questions about symptoms in the

previous 4 weeks regarding daytime asthma symptoms more than twice per week, night waking, the need for a reliever more than twice per week, and activity limitation due to asthma. This system is sometimes used to assess the validity of other asthma assessment tools.²¹ GINA guidelines²⁰ also recommend a separate assessment of ~20 risk factors for poor asthma outcomes, such as exacerbations, fixed airflow limitation, and medication adverse effects.

Asthma Quality of Life Questionnaire

Clinical trials historically used only physiologic and clinical outcomes to assess interventions, without measuring the effect on the lives of patients. To address this gap, a questionnaire for measuring quality of life in adults with asthma was developed and published in 1992.²² The Asthma Quality of Life Questionnaire (AQLQ) has 32 items, including five questions on the activity types to be selected by the patient.²² A standardized version, AQLQ(S), was later developed, with five generic activities (strenuous exercise, moderate exercise, work-related activities, social activities, and sleep) to replace the patient-specific activities.²³ The AQLQ(S) was similar to the previous AQLQ in terms of reliability, responsiveness, and construct validity. To enhance its utilization, a MiniAQLQ²⁴ with 15 items was developed with similar validity to the original 32-item questionnaire, although slightly less reliability. Because some asthma clinical trials for adults lowered the age limit to 12 years, the AQLQ(S) was modified in 2005 to make it valid for patients ages ≥ 12 years (AQLQ12+).²⁵

Asthma Control Questionnaire

The Asthma Control Questionnaire (ACQ) was published in 1999.²⁶ The goal was to assess asthma control to guide management. Six items about asthma symptoms during the past week are answered by the patient, and the seventh item is a score based on the forced expiratory volume in the first second of expiration (FEV₁) % predicted. It can be accessed with permission from the investigators.²

Asthma Therapy Assessment Questionnaire

The Asthma Therapy Assessment Questionnaire (ATAQ) was developed as a disease management tool to identify individuals whose asthma management may be suboptimal.²⁷ The questionnaire has questions about four aspects of control: self-perception, missed activities, nighttime waking, and use of rescue inhalers. The ATAQ for children and adolescents was subsequently developed to identify children at risk for adverse asthma outcomes.²⁸ This parent questionnaire contains 20 items to assess symptom control, behavior and attitude barriers, self-efficacy barriers, and communica-

tion gaps. It has been validated among children ages 5–17 years enrolled in managed care organizations in the United States.

Lara Asthma Symptom Scale

The Lara Asthma Symptom Scale (LASS) was reported in 2000 as a symptom scale to evaluate asthma control in children.²⁹ The questionnaire contains eight items answered by parents and is reliable and valid in both English and Spanish. As reported in 2007, the same questionnaire was tailored for adults and showed high reliability and correlation with baseline FEV₁, AQLQ, frequency of emergency visits, and number of hospitalizations.³⁰ Changes in LASS scores over time were also found to correlate with changes in FEV₁.

Asthma Control Test

The Asthma Control Test (ACT) was developed as a simple method for assessing asthma control in busy clinical practices.³¹ Initially, a 22-item questionnaire was tested on 471 patients at asthma specialty clinics. This was narrowed to a subset of items that showed the greatest discriminant validity compared with their asthma specialist's rating of asthma control. These items assess impaired functioning, shortness of breath, nighttime symptoms, rescue medication use, and patient perception of control. The final 5-item questionnaire scores correlate with specialist-determined asthma control, need for therapy change, and FEV₁% predicted.

Pediatric Asthma Control Tool

The Pediatric Asthma Control Tool (PACT) was subsequently developed to fill a need for a brief instrument to administer at health care visits to parents of patients ages <19 years.³² Ten items address the frequency of flares and symptoms in-between flares over the past 3 months. Parents answer questions about the frequency of asthma flares, duration of flares, frequency of oral steroids, emergency visits, and overnight hospital stays; questions about symptoms in-between flares address light activity, sports, sleep, mornings, and use of quick-relief medicine. The PACT correlated with expert assessment.

Asthma Control Scoring System

In 2007, the Asthma Control Scoring System (ACSS), based on criteria proposed by the Canadian Asthma Consensus Guidelines, was published.³³ The ACSS evaluates three parameters (clinical, physiologic, and inflammatory) and gives a global score based on the mean of these parameter scores; the clinical score includes daily symptoms, night symptoms, β_2 -agonist use, and physical activity limitations; the physiologic score includes peak expiratory flow, FEV₁, and varia-

Table 3 Atopic dermatitis scoring systems

Scoring System	Study, y	Intended Use	Number of Items
SSS	Costa <i>et al.</i> , ³⁴ 1989	Simple system to assess severity of atopic dermatitis	20
EASI	Tofte <i>et al.</i> , ³⁵ 1989	Area and severity score for use in clinical trials	20
SCORAD	Consensus Report of the European Task Force on Atopic Dermatitis, ³⁸ 1993	Standardized severity score for atopic dermatitis to be used to interpret therapeutic studies	9
SASSAD	Berth-Jones, ⁴⁰ 1996	Simple and effective system for recording and monitoring disease activity in clinical trials	36
TIS	Wolkerstorfer <i>et al.</i> , ⁴¹ 1999	Less time-consuming severity score for routine clinical use	3
POEM	Charman <i>et al.</i> , ⁴² 2004	Assess symptoms of atopic dermatitis for both routine clinical practice and clinical trials	7
CAPS	Drucker <i>et al.</i> , ⁴³ 2018	Efficient method to assess atopic dermatitis severity in routine clinical practice	4

SSS = Simple Scoring System; EASI = Eczema Area and Severity Index; SCORAD = Score for Atopic Dermatitis; SASSAD = Six Area, Six Sign Atopic Dermatitis severity score; TIS = Three Item Severity; POEM = Patient-Oriented Eczema Measure; CAPS = Clinical extent, Area, Pruritus, Sleep.

tion in peak expiratory flow; and the inflammatory score is based on sputum eosinophilia.³³

ATOPIC DERMATITIS

Atopic dermatitis scoring systems are summarized in Table 3.

Simple Scoring System

In 1989, the Simple Scoring System (SSS) for evaluating the severity of atopic dermatitis was reported.³⁴ The SSS includes 10 severity criteria (erythema, edema, vesicles, crusts, excoriations, scales, lichenification, pigmentation, pruritus, and loss of sleep) (score, 0–7) and 10 topographic sites (score, 0–3) according to the extent of involvement.³⁴ It was compared with a more complicated and complete system of evaluation and found to have significant correlation and higher reproducibility.³⁴

Eczema Area and Severity Index

The Eczema Area and Severity Index (EASI) was first presented at a dermatology meeting in 1989.³⁵ Four body regions (head and neck, upper limbs, trunk, and lower limbs) are assessed for the area of involvement, erythema, induration and/or papulation and/or edema, excoriations, and lichenification.³⁵ The investigators subsequently published a validation study verifying acceptable intra-evaluator reliability.³⁶ The EASI³⁵ was

used in randomized controlled clinical trials for topical pimecrolimus, and data from these trials showed that EASI has good validity, reliability, and sensitivity.³⁷

Score for Atopic Dermatitis

In 1993, the European Task Force on Atopic Dermatitis reported on the Score for Atopic Dermatitis (SCORAD) index,³⁸ a severity score for atopic dermatitis that was standardized and could be used to interpret therapeutic studies. The SCORAD index³⁸ combines extent, intensity, and subjective criteria. The extent score is the percentage of body surface area involved divided by 5. The intensity score is erythema, papulation and/or edema, oozing and/or crusting, excoriation, lichenification, and dryness each with a score of 0–3; the total is then multiplied by 7 and divided by 2; the subjective score is sleep loss and irritability each with a score from 0 to 10.³⁸ The three criteria are added for a total score of 103. A subsequent clinical validation study of interobserver variability showed the benefit of training for physician scorers.³⁹ The SCORAD index is a commonly used system.

Six Area, Six Sign Atopic Dermatitis Severity Score

The Six Area, Six Sign Atopic Dermatitis (SASSAD) severity score evolved over a decade during clinical trials for atopic dermatitis before a version was published in 1996.⁴⁰ The purpose was to report a simple and effective system for recording and monitoring dis-

Table 4 Urticaria scoring systems

Scoring System	Study, y	Intended Use	Number of Items
CU-Q ₂ oL	Baiardini <i>et al.</i> , ⁴⁵ 2005	vAssess quality of life in patients with chronic urticaria	23
UAS	Mlynek <i>et al.</i> , ⁴⁸ 2008	Assess daily wheal numbers and pruritus intensity in clinical trials	2 for each day assessed (generally 7 days)
Dermographometers	Maurer <i>et al.</i> , ⁵⁰ 2018	Threshold testing in inducible urticaria	Not applicable

CU-Q₂oL = Chronic Urticaria Quality of Life; UAS = Urticaria Activity Score.

ease activity of atopic dermatitis for clinical trials. The six signs evaluated are erythema, exudation, excoriation, dryness, cracking, and lichenification.⁴⁰ Each of these is given a score of 0 to 3 at six areas: head and neck, hands, arms, trunk, feet, and legs. The score is applicable to both children and adults.

Three-Item Severity Score

Because the SCORAD index is complicated and time consuming for routine clinical use, the Three-Item Severity (TIS) score was developed and published in 1999.⁴¹ Erythema, edema and/or papulation, and excoriation are evaluated on a scale from 0 to 3. A prospective study in children found a positive correlation between the TIS and the SCORAD index, but the TIS interobserver agreement was lower.

Patient-Oriented Eczema Measure

The Patient-Oriented Eczema Measure (POEM)⁴² was developed by using patient interviews to identify symptoms of atopic dermatitis and was published in 2004. Seven symptoms (itching, sleep disturbance, bleeding, weeping and/or oozing, cracking, flaking, and dryness and/or roughness) are assessed regarding frequency during the previous week and with a score of 0–4. The POEM showed good correlation with quality-of-life indexes, internal consistency, reliability, and sensitivity to change. The intended use is for both routine clinical practice and for clinical trials.

Clinical Extent, Area, Pruritus, Sleep Measure for Atopic Dermatitis Severity

Due to the time-consuming nature of many of the existing measures of atopic dermatitis severity, the Clinical Extent, Area, Pruritus, Sleep (CAPS) measure for atopic dermatitis severity was recently developed and pilot tested.⁴³ It includes two clinician-assessed questions (the signs subscale) and two patient-assessed questions (the symptoms subscale). For the signs subscale, the clinician assesses body surface area involved

(score of 0–5 and multiplied by 2) and the severity of the worst lesion on the patient at that the assessment (score of 0–5 and multiplied by 2). For the symptoms subscale, the patient reports severity of itching and sleep, each on a scale of 10; the total score is 40. The CAPS measure was validated in a pilot study of 25 patients and found to correlate with other outcome measures such as EASI and POEM.⁴³ Other outcome measurements for atopic dermatitis exist, but the SCORAD, EASI, and POEM have been tested sufficiently and are frequently used.⁴⁴

URTICARIA

Urticaria scoring systems are summarized in Table 4.

Chronic Urticaria Quality of Life Questionnaire

The Chronic Urticaria Quality of Life (CU-Q₂oL) was published in 2005.⁴⁵ The questionnaire assesses pruritus, swelling, impact on life activities, sleep problems, looks, and limits by using 23 questions each with a score from 1 to 5. Validation showed reliability and responsiveness to clinical changes. Versions of the CU-Q₂oL in Portuguese⁴⁶ and German⁴⁷ have been validated.

Urticaria Activity Score

The Urticaria Activity Score (UAS) combines daily wheal numbers and pruritus intensity.⁴⁸ The UAS showed weak correlation ($r^2 = 0.31$) with the Dermatology Life Quality Index, with improvement when the UAS is assessed for at least 4 consecutive days. The UAS7, which assesses 7 consecutive days, and the UAS7TD, with twice-daily documentation, correlate well with each other and have been used in clinical trials.⁴⁹

Dermographometers and Other Devices for Inducible Urticaria

Dermographometers are devices that can assist clinicians in testing inducible urticaria by using defined pres-

Table 5 Eosinophilic esophagitis scoring systems

Scoring System	Study, y	Intended use	Number of Items
PEESS	Pentiuk <i>et al.</i> , ⁵³ 2009	Examine clinical manifestations and attempt to correlate symptoms with histologic disease severity	18
PEESS v2.0	Franciosi <i>et al.</i> , ⁵⁴ 2011	Measure outcomes in pediatric EoE which are relevant to families	20
EREFS	Hirano <i>et al.</i> , ⁵⁵ 2013	Standardized classification to describe endoscopic findings in EoE	6
DSQ	Dellon <i>et al.</i> , ⁵⁶ 2013	Patient-reported outcome for dysphagia in subjects with EoE for use in clinical trials	3
EEsAI	Schoepfer <i>et al.</i> , ⁵⁸ 2014	Comprehensive symptom score	19
EoEHSS	Collins <i>et al.</i> , ⁵⁹ 2017	Objectively assess histologic changes in the esophagus beyond eosinophil number	16

PEESS = Pediatric Eosinophilic Esophagitis Symptom Score; EoE = eosinophilic esophagitis; EREFS = Eosinophilic Esophagitis Endoscopic Reference Score; DSQ = Dysphagia Symptom Questionnaire; EEsAI = Eosinophilic Esophagitis Activity Index; EoEHSS = Eosinophilic Esophagitis Histologic Scoring System.

tures.⁵⁰ The HTZ dermatographometer is pen shaped with a steel tip of 2.3 mm in diameter and tip pressures that range from 20 to 160 g/mm², which can be used to determine the patient's trigger threshold. Another available device is the FricTest, which unlike the HTZ device, is shaped like a comb with four tips, 3 mm in diameter, in four lengths (3.0, 3.5, 4.0, and 4.5 mm). For temperature-related urticaria, the TempTest is a device that can apply temperatures from 4 to 44°C to allow standardized provocation tests and to determine stimulation thresholds for cold and heat provocation.⁵¹

STEVENS-JOHNSON SYNDROME/TOXIC EPIDERMAL NECROLYSIS

Severity-of-Illness Score for Toxic Epidermal Necrolysis

Stevens-Johnson Syndrome/Toxic Epidermal Necrolysis is associated with a high mortality rate, which led Bastuji-Garin *et al.*⁵² to develop a predictive scoring system for in-hospital mortality. One point is given to each of seven risk factors: age >40 years, malignancy, tachycardia >120/min, initial epidermal detachment >10%, serum urea level >10 mmol/L, serum glucose level >14 mmol/L, and bicarbonate level <20 mmol/L. A Severity-of-Illness Score for Toxic Epidermal Necrolysis (SCORTEN) of 0–1 predicts 3% mortality, 2 predicts 12% mortality, 3 predicts 35% mortality, 4 predicts 58% mortality, and ≥5 predicts 90% mortality.⁵²

EOSINOPHILIC ESOPHAGITIS

Eosinophilic esophagitis (EoE) scoring systems are summarized in Table 5.

Pediatric Eosinophilic Esophagitis Symptom Score

In 2009, the Pediatric Eosinophilic Esophagitis Symptom Score (PEESS) was reported and compared with histologic findings in the esophagus.⁵³ The symptom survey was initially developed to examine the spectrum of clinical manifestations and attempt to correlate symptoms with histologic disease severity. The score measured frequency (score, 0–5) and severity (score, 0–3) of symptoms of nausea, vomiting, abdominal pain, chest pain, heartburn, regurgitation, dysphagia, food impaction, poor appetite, early satiety, and inadequate weight gain. Higher scores were found in untreated children, but histologic resolution did not correlate with improvement in the symptoms score. A content-validated PEESS v2.0 was developed and published in 2011.⁵⁴ This version includes 20 questions, similar to the initial score, that can be answered either by patients 8–18 years of age or by parents of children 2–18 years.

Eosinophilic Esophagitis Endoscopic Reference Score

Due to lack of a standardized classification to describe endoscopic findings in EoE, the Eosinophilic Esophagitis Endoscopic Reference Score (EREFS) was developed.⁵⁵ This grading system includes fixed rings (grade, 0–3), exudates (grade, 0–2), furrows (grade, 0–1), edema (grade, 0–1), strictures (grade, 0–1), and crepe paper esophagus (grade, 0–1). This system showed good inter-observer agreement among gastroenterologists.

Dysphagia Symptom Questionnaire

Published in 2013, the Dysphagia Symptom Questionnaire (DSQ) was developed as a validated patient-

Table 6 Systemic allergic reaction severity scores

Severity Score	Study, y	Intended Use	Number of Items/grades
Brown severity of anaphylaxis	Brown, ⁶⁰ 2004	Grade systemic reactions and define anaphylaxis	3
WAO systemic reaction grading system	Cox <i>et al.</i> , ⁶² 2017	Help clinicians accurately assess when epinephrine should be administered in systemic reactions	5
Niggemann and Beyer allergic reaction grading system	Niggemann and Beyer, ⁶³ 2016	Simple 3-grade system to use in daily practice to classify the severity of allergic reactions	3

WAO = World Allergy Organization.

reported outcome for dysphagia in subjects with EoE for use in clinical trials.⁵⁶ A field trial was conducted with adolescents and adults with EoE, active symptoms of dysphagia, and esophageal eosinophilia. The score is based on three questions answered on a daily basis about whether solid food was avoided, whether dysphagia occurred, and whether actions needed to be taken to get relief. DSQ version 4.0 has since been published with the addition of a question about odynophagia.⁵⁷ It showed strong reliability and responsiveness.

Eosinophilic Esophagitis Activity Index

Published in 2014, the Eosinophilic Esophagitis Activity Index (EEsAI) is a comprehensive score that includes the following: trouble swallowing frequency (score of 0, 15, 27, or 31) and duration (score of 0 or 6), pain when swallowing (score of 0 or 15), a visual dysphagia question to address the severity of dysphagia while eating foods of different consistencies (score of 0, 12, 19, 21, 23), and behavioral adaptations in the form of avoidance, modification, and slow eating (score of 0, 9, or 25).⁵⁸ The score is based on a 7-day recall period and is validated in patients ages ≥ 17 years.

Eosinophilic Esophagitis Histologic Scoring System

Rather than symptoms, the Eosinophilic Esophagitis Histologic Scoring System (EoEHSS) was developed to objectively assess histologic changes in the esophagus beyond the eosinophil number.⁵⁹ The score is based on grade (score, 0–3) and stage (score, 0–3) of eight features: eosinophil density, basal zone hyperplasia, eosinophil abscesses, eosinophil surface layering, dilated intercellular spaces, surface epithelial alteration, dyskeratotic epithelial cells, and lamina propria fibrosis. It discriminates treated from untreated patients.⁵⁹

SYSTEMIC ALLERGIC REACTIONS

Systemic allergic reaction scoring systems are summarized in Table 6.

Brown Severity of Anaphylaxis

The Brown severity of anaphylaxis was a score published in 2004 in an effort to create a simple grading system and definition of anaphylaxis.⁶⁰ Retrospective analysis of patients with systemic hypersensitivity reactions who presented to an emergency department revealed associations between individual reaction features and hypotension and hypoxia. These were used to create a grading system that was found to correlate well with epinephrine usage. Severe reactions include those with confusion, collapse, unconsciousness, and incontinence, which were strongly associated with hypotension and hypoxia; moderate reactions are those with diaphoresis, vomiting, presyncope, dyspnea, stridor, wheeze, chest and/or throat tightness, nausea, vomiting, and abdominal pain; and mild reactions are limited to the skin with urticaria, erythema, and angioedema.⁶⁰

World Allergy Organization Systemic Reaction Grading System

In 2010, the World Allergy Organization published a grading system to help clinical assessment of systemic reactions to subcutaneous allergy immunotherapy and the need for epinephrine administration.⁶¹ It is based on the organ system involved and degree of severity. Grade 1 is for a single organ system, either cutaneous, conjunctival, or upper respiratory; grade 2 is for more than one organ system or lower respiratory symptoms that respond to inhaled bronchodilator, or gastrointestinal symptoms, or uterine cramps; grade 3 is for laryngeal and/or uvula and/or tongue edema, or lower respiratory symptoms not responding to inhaled bronchodilator; grade 4 is for respiratory failure or hypotension; and grade 5 is for fatal reactions.⁶¹ In 2017, this grading system for immunotherapy reactions was modified to allow application to allergic reactions to any cause.⁶² Grade 1 reactions also includes nausea or metallic taste; grade 2 reactions involve two or more of the symptoms from grade 1; grade 3 reactions involve

mild bronchospasm that responds to treatment, abdominal cramps and/or vomiting and/or diarrhea, or uterine cramps plus any symptoms and/or signs from grade 1; grade 4 reactions include severe bronchospasm and/or laryngeal edema with stridor and any symptoms/signs from grades 1 or 3; and grade 5 reactions include respiratory failure and/or cardiovascular collapse/hypotension/loss of consciousness and any symptoms/signs from grades 1, 3, or 4. Grades 4 and 5 are considered anaphylaxis.

Niggemann and Beyer Allergic Reaction Grading System

In 2015, Niggemann and Beyer⁶³ proposed a simplified 3-grade system to use in daily practice to classify the severity of allergic reactions. Local reactions (redness, swelling, pruritus) are grade I, mild-to-moderate systemic reactions (urticaria, angioedema, flush, gastrointestinal) are grade II, and severe systemic reactions (respiratory, cardiovascular) consistent with anaphylaxis are grade III.

CONCLUSION

Several scoring systems for asthma and allergic diseases have been developed, most of which were validated. They were briefly presented in this review. Their application has been proven very useful in assessing disease severity, designing clinical trials, comparing therapeutic modalities, fair comparison of studies' findings, and monitoring disease course in clinical practice.

REFERENCES

1. Juniper EF, Guyatt GH. Development and testing of a new measure of health status for clinical trials in rhinoconjunctivitis. *Clin Exp Allergy*. 1991; 21:77–83.
2. Juniper EF. Measurement of Health-Related Quality of Life & Asthma Control: Obtaining Questionnaires. Available from <https://www.qoltech.co.uk/obtaining.html>; Accessed December 3, 2018.
3. Juniper EF, Thompson AK, Ferrie PJ, Roberts JN. Development and validation of the mini Rhinoconjunctivitis Quality of Life Questionnaire. *Clin Exp Allergy*. 2000; 30:132–140.
4. Bousquet J, Van Cauwenberge P, Khaltaev N, Aria Workshop Group, and World Health Organization. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol*. 2001; 108:S147–S334.
5. Bousquet J, Khaltaev N, Cruz AA, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). *Allergy*. 2008; 63(Suppl 86):8–160.
6. Spector SL, Nicklas RA, Chapman JA, et al. Symptom severity assessment of allergic rhinitis: part 1. *Ann Allergy Asthma Immunol*. 2003; 91:105–114.
7. Wallace DV, Dykewicz MS, Bernstein DI, et al. The diagnosis and management of rhinitis: an updated practice parameter. *J Allergy Clin Immunol*. 2008; 122:S1–S84.
8. Bousquet J, Arnavielhe S, Bedbrook A, et al. The Allergic Rhinitis and its Impact on Asthma (ARIA) score of allergic rhinitis using mobile technology correlates with quality of life: The MASK study. *Allergy*. 2018; 73:505–510.
9. Nogueira-Silva L, Martins SV, Cruz-Correia R, et al. Control of allergic rhinitis and asthma test—a formal approach to the development of a measuring tool. *Respir Res*. 2009; 10:52.
10. Fonseca JA, Nogueira-Silva L, Morais-Almeida M, et al. Validation of a questionnaire (CARAT10) to assess rhinitis and asthma in patients with asthma. *Allergy*. 2010; 65:1042–1048.
11. Borrego LM, Fonseca JA, Pereira AM, Pinto VR, Linhares D, Morais-Almeida M. Development process and cognitive testing of CARATkids - Control of Allergic Rhinitis and Asthma Test for children. *BMC Pediatr*. 2014; 14:34.
12. Linhares DV, da Fonseca JA, Borrego LM, et al. Validation of control of allergic rhinitis and asthma test for children (CARATKIDS)—a prospective multicenter study. *Pediatr Allergy Immunol*. 2014; 25:173–179.
13. Emons JA, Flokstra BM, de Jong C, et al. Use of the Control of Allergic Rhinitis and Asthma Test (CARATkids) in children and adolescents: Validation in Dutch. *Pediatr Allergy Immunol*. 2017; 28:185–190.
14. Amaral R, Carneiro AC, Wandalsen G, Fonseca JA, Sole D. Control of Allergic Rhinitis and Asthma Test for Children (CARATKIDS): Validation in Brazil and cutoff values. *Ann Allergy Asthma Immunol*. 2017; 118:551–556.e2.
15. Nathan RA, Dalal AA, Stanford RH, et al. Qualitative Development of the Rhinitis Control Assessment Test (RCAT), an instrument for evaluating rhinitis symptom control. *Patient*. 2010; 3:91–99.
16. Schatz M, Meltzer EO, Nathan R, et al. Psychometric validation of the rhinitis control assessment test: a brief patient-completed instrument for evaluating rhinitis symptom control. *Ann Allergy Asthma Immunol*. 2010; 104:118–124.
17. Demoly P, Jankowski R, Chassany O, Bessah Y, Allaert FA. Validation of a self-questionnaire for assessing the control of allergic rhinitis. *Clin Exp Allergy*. 2011; 41:860–868.
18. Wang Y, Chen H, Zhu R, et al. Allergic Rhinitis Control Test questionnaire-driven stepwise strategy to improve allergic rhinitis control: a prospective study. *Allergy*. 2016; 71:1612–1619.
19. Zhu R, Wang J, Wu Y, et al. The Allergic Rhinitis Control Test Questionnaire is valuable in guiding step-down pharmacotherapy treatment of allergic rhinitis. *J Allergy Clin Immunol Pract*. 2018. pii: S2213–2198(18)30351–9. [Epub ahead of print]
20. 2018 GINA Report, Global Strategy for Asthma Management and Prevention.
21. Vermeulen F, de Meulder I, Paesmans M, Muylle I, Bruyneel M, Ninane V. Asthma control measurement using five different questionnaires: A prospective study. *Respir Med*. 2013; 107:1314–1321.
22. Juniper EF, Guyatt GH, Epstein RS, Ferrie PJ, Jaeschke R, Hiller TK. Evaluation of impairment of health related quality of life in asthma: development of a questionnaire for use in clinical trials. *Thorax*. 1992; 47:76–83.
23. Juniper EF, Buist AS, Cox FM, Ferrie PJ, King DR. Validation of a standardized version of the Asthma Quality of Life Questionnaire. *Chest*. 1999; 115:1265–1270.
24. Juniper EF, Guyatt GH, Cox FM, Ferrie PJ, King DR. Development and validation of the Mini Asthma Quality of Life Questionnaire. *Eur Respir J*. 1999; 14:32–38.
25. Juniper EF, Svensson K, Mörk AC, Ståhl E. Modification of the asthma quality of life questionnaire (standardised) for patients 12 years and older. *Health Qual Life Outcomes*. 2005; 3:58.
26. Juniper EF, O'Byrne PM, Guyatt GH, Ferrie PJ, King DR. Development and validation of a questionnaire to measure asthma control. *Eur Respir J*. 1999; 14:902–907.
27. Vollmer WM, Markson LE, O'Connor E, et al. Association of asthma control with health care utilization and quality of life. *Am J Respir Crit Care Med*. 1999; 160:1647–1652.

28. Skinner EA, Diette GB, Algatt-Bergstrom PJ, et al. The Asthma Therapy Assessment Questionnaire (ATAQ) for children and adolescents. *Dis Manag.* 2004; 7:305–313.
29. Lara M, Sherbourne C, Duan N, Morales L, Gergen P, Brook RH. An English and Spanish Pediatric Asthma Symptom Scale. *Med Care.* 2000; 38:342–350.
30. Wood PR, Smith B, O'Donnell L, et al. Quantifying asthma symptoms in adults: the Lara Asthma Symptom Scale. *J Allergy Clin Immunol.* 2007; 120:1368–1372.
31. Nathan RA, Sorkness CA, Kosinski M, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol.* 2004; 113:59–65.
32. Zorc JJ, Pawlowski NA, Allen JL, et al. Development and validation of an instrument to measure asthma symptom control in children. *J Asthma.* 2006; 43:753–758.
33. LeBlanc A, Robichaud P, Lacasse Y, Boulet LP. Quantification of asthma control: validation of the Asthma Control Scoring System. *Allergy.* 2007; 62:120–125.
34. Costa C, Rilliet A, Nicolet M, Saurat JH. Scoring atopic dermatitis: the simpler the better? *Acta Derm Venereol.* 1989; 69: 41–45.
35. Tofte S, Graeber M, Cherill R, et al. Eczema area and severity index (EASI): A new tool to evaluate atopic dermatitis. *J Eur Acad Dermatol Venereol.* 1989; 11:S197.
36. Hanifin JM, Thurston M, Omoto M, Cherill R, Tofte SJ, Graeber M. The eczema area and severity index (EASI): assessment of reliability in atopic dermatitis. EASI Evaluator Group. *Exp Dermatol.* 2001; 10:11–18.
37. Barbier N, Paul C, Luger T, et al. Validation of the Eczema Area and Severity Index for atopic dermatitis in a cohort of 1550 patients from the pimecrolimus cream 1% randomized controlled clinical trials programme. *Br J Dermatol.* 2004; 150:96–102.
38. Severity scoring of atopic dermatitis: the SCORAD index. Consensus Report of the European Task Force on Atopic Dermatitis. *Dermatology.* 1993; 186:23–31.
39. Kunz B, Oranje AP, Labrèze L, Stalder JF, Ring J, Taïeb A. Clinical validation and guidelines for the SCORAD index: consensus report of the European Task Force on Atopic Dermatitis. *Dermatology.* 1997; 195:10–19.
40. Berth-Jones J. Six area, six sign atopic dermatitis (SASSAD) severity score: a simple system for monitoring disease activity in atopic dermatitis. *Br J Dermatol.* 1996; 135(Suppl 48):25–30.
41. Wolkerstorfer A, de Waard van der Spek FB, Glazenburg EJ, Mulder PG, Oranje AP. Scoring the severity of atopic dermatitis: three item severity score as a rough system for daily practice and as a pre-screening tool for studies. *Acta Derm Venereol.* 1999; 79:356–359.
42. Charman CR, Venn AJ, Williams HC. The patient-oriented eczema measure: development and initial validation of a new tool for measuring atopic eczema severity from the patients' perspective. *Arch Dermatol.* 2004; 140:1513–1519.
43. Drucker AM, Matthews NH, Muglia J, Qureshi AA. Pilot study of the CAPS (Clinical extent, Area, Pruritus, Sleep) measure for atopic dermatitis severity. *Ann Allergy Asthma Immunol.* 2018; 121:380–381.
44. Schmitt J, Langan S, Williams HC. What are the best outcome measurements for atopic eczema? A systematic review. *J Allergy Clin Immunol.* 2007; 120:1389–1398.
45. Baiardini I, Pasquali M, Braidò F, et al. A new tool to evaluate the impact of chronic urticaria on quality of life: chronic urticaria quality of life questionnaire (CU-QoL). *Allergy.* 2005; 60: 1073–1078.
46. Dias GA, Pires GV, Valle SO, et al. Cross-cultural adaptation of the Brazilian-Portuguese version of the chronic urticaria quality-of-life questionnaire - CU-Q2oL. *Allergy.* 2011; 66:1487–1493.
47. Mlyněk A, Magerl M, Hanna M, et al. The German version of the Chronic Urticaria Quality-of-Life Questionnaire: factor analysis, validation, and initial clinical findings. *Allergy.* 2009; 64: 927–936.
48. Mlyněk A, Zalewska-Janowska A, Martus P, Staubach P, Zuberbier T, Maurer M. How to assess disease activity in patients with chronic urticaria? *Allergy.* 2008; 63:777–780.
49. Hollis K, Proctor C, McBride D, et al. Comparison of Urticaria Activity Score Over 7 Days (UAS7) Values Obtained from Once-Daily and Twice-Daily Versions: Results from the ASSURE-CSU Study. *Am J Clin Dermatol.* 2018; 19:267–274.
50. Maurer M, Fluhr JW, Khan DA. How to approach chronic inducible urticaria. *J Allergy Clin Immunol Pract.* 2018; 6:1119–1130.
51. Magerl M, Abajian M, Krause K, Altrichter S, Siebenhaar F, Church MK. An improved Peltier effect-based instrument for critical temperature threshold measurement in cold- and heat-induced urticaria. *J Eur Acad Dermatol Venereol.* 2015; 29:2043–2045.
52. Bastuji-Garin S, Fouchard N, Bertocchi M, Roujeau JC, Revuz J, Wolkenstein P. SCORTEN: a severity-of-illness score for toxic epidermal necrolysis. *J Invest Dermatol.* 2000; 115:149–153.
53. Pentiu S, Putnam PE, Collins MH, Rothenberg ME. Dissociation between symptoms and histological severity in pediatric eosinophilic esophagitis. *J Pediatr Gastroenterol Nutr.* 2009; 48:152–160.
54. Franciosi JP, Hommel KA, DeBrosse CW, et al. Development of a validated patient-reported symptom metric for pediatric eosinophilic esophagitis: qualitative methods. *BMC Gastroenterol.* 2011; 11:126.
55. Hirano I, Moy N, Heckman MG, Thomas CS, Gonsalves N, Achem SR. Endoscopic assessment of the oesophageal features of eosinophilic oesophagitis: validation of a novel classification and grading system. *Gut.* 2013; 62:489–495.
56. Dellon ES, Irani AM, Hill MR, Hirano I. Development and field testing of a novel patient-reported outcome measure of dysphagia in patients with eosinophilic esophagitis. *Aliment Pharmacol Ther.* 2013; 38:634–642.
57. Hudgens S, Evans C, Phillips E, Hill M. Psychometric validation of the Dysphagia Symptom Questionnaire in patients with eosinophilic esophagitis treated with budesonide oral suspension. *J Patient Rep Outcomes.* 2017; 1:3.
58. Schoepfer AM, Straumann A, Panczak R, et al. Development and validation of a symptom-based activity index for adults with eosinophilic esophagitis. *Gastroenterology.* 2014; 147: 1255–1266.e21.
59. Collins MH, Martin LJ, Alexander ES, et al. Newly developed and validated eosinophilic esophagitis histology scoring system and evidence that it outperforms peak eosinophil count for disease diagnosis and monitoring. *Dis Esophagus.* 2017; 30:1–8.
60. Brown SG. Clinical features and severity grading of anaphylaxis. *J Allergy Clin Immunol.* 2004; 114:371–376.
61. Cox L, Larenas-Linnemann D, Lockey RF, Passalacqua G. Speaking the same language: The World Allergy Organization subcutaneous immunotherapy systemic reaction grading system. *J Allergy Clin Immunol.* 2010; 125:569–574, 574.e1–574.e7.
62. Cox LS, Sanchez-Borges M, Lockey RF. World Allergy Organization systemic allergic reaction grading system: is a modification needed? *J Allergy Clin Immunol Pract.* 2017; 5:58–62.e5.
63. Niggemann B, Beyer K. Time for a new grading system for allergic reactions? *Allergy.* 2016; 71:135–136. □

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