Hereditary Angioedema (HAE), Treatment and Prophylaxis

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INSTRUCTIONS FOR USE

This Drug Policy provides assistance in interpreting UnitedHealthcare benefit plans. When deciding coverage, the member specific benefit plan document must be referenced. The terms of the member specific benefit plan document [e.g., Certificate of Coverage (COC), Schedule of Benefits (SOB), and/or Summary Plan Description (SPD)] may differ greatly from the standard benefit plan upon which this Drug Policy is based. In the event of a conflict, the member specific benefit plan document supersedes this Drug Policy. All reviewers must first identify member eligibility, any federal or state regulatory requirements, and the member specific benefit plan coverage prior to use of this Drug Policy. Other Policies and Coverage Determination Guidelines may apply. UnitedHealthcare reserves the right, in its sole discretion, to modify its Policies and Guidelines as necessary. This Drug Policy is provided for informational purposes. It does not constitute medical advice.

UnitedHealthcare may also use tools developed by third parties, such as the MCG™ Care Guidelines, to assist us in administering health benefits. The MCG™ Care Guidelines are intended to be used in connection with the independent professional medical judgment of a qualified health care provider and do not constitute the practice of medicine or medical advice.

BENEFIT CONSIDERATIONS

Some Certificates of Coverage allow for coverage of experimental/investigational/unproven treatments for life-threatening illnesses when certain conditions are met. The enrollee-specific benefit document must be consulted to make coverage decisions for this service. Some states mandate benefit coverage for off-label use of medications for some diagnoses or under some circumstances when certain conditions are met. Where such mandates apply, they supersede language in the benefit document or in the medical or drug policy. Benefit coverage for an otherwise unproven service for the treatment of serious rare diseases may occur when certain conditions are met. See the Policy and Procedure addressing the treatment of serious rare diseases.

Essential Health Benefits for Individual and Small Group
For plan years beginning on or after January 1, 2014, the Affordable Care Act of 2010 (ACA) requires fully insured non-grandfathered individual and small group plans (inside and outside of Exchanges) to provide coverage for ten categories of Essential Health Benefits (“EHBs”). Large group plans (both self-funded and fully insured), and small group ASO plans, are not subject to the requirement to offer coverage for EHBs. However, if such plans choose to provide coverage for benefits which are deemed EHBs, the ACA requires all dollar limits on those benefits to be removed on all Grandfathered and Non-Grandfathered plans. The determination of which benefits constitute EHBs is made on a state by state basis. As such, when using this policy, it is important to refer to the member specific benefit plan document to determine benefit coverage.
This policy refers to the following drug products:

C1 Esterase Inhibitor [human]
- Berinert® (for intravenous injection)
- Cinryze® (for intravenous injection)

C1 Esterase Inhibitor [recombinant]
- Ruconest® (for intravenous injection)

Plasma Kallikrein Inhibitor [human]
- Kalbitor® (ecallantide, for subcutaneous injection)

1. Berinert, Ruconest, and Kalbitor are **proven and medically necessary** for the treatment of hereditary angioedema (HAE) when **both** of the following are met:
   a. Used for treatment of an **acute** HAE attack
      **AND**
   b. Not used in combination with other approved treatments for acute HAE attacks (e.g. Berinert, Cinryze, Firazyr, Kalbitor or Ruconest)

2. Cinryze is **proven** for the treatment of Hereditary angioedema (HAE) when **one** of the following are met:
   a. Used for **prophylaxis** against HAE attacks
      **OR**
   b. **Both** of the following:
      (1) Used for treatment of an **acute** HAE attack
      **AND**
      (2) Not used in combination with other approved treatments for acute HAE attacks (e.g. Berinert, Cinryze, Firazyr, Kalbitor or Ruconest)

Additional information to support medical necessity review for Cinryze where applicable:
Cinryze is **medically necessary** for the treatment of hereditary angioedema (HAE) when **both** of the following are met:

a. **One** of the following:
   1. **Both** of the following:
      (a) For prophylaxis against HAE attacks
      **AND**
      (b) **One** of the following:
         i. For continuation of prior therapy
         **OR**
         ii. History of failure, contraindication, or intolerance of **one** of the following:
            (i) 17-alpha alkylated androgen (e.g., danazol, oxandrolone)
            **OR**
            (ii) Antifibrinolytics (e.g., aminocaproic acid, tranexamic acid)
            **OR**
   2. **Both** of the following:
      (a) Used for treatment of an **acute** HAE attack
      **AND**
      (b) Not used in combination with other approved treatments for acute HAE attacks (e.g. Berinert, Firazyr, Kalbitor or Ruconest)
      **AND**

b. Prescribed by **one** of the following
   1. Immunologist
   2. Allergist
   3. Rheumatologist

U.S. FOOD AND DRUG ADMINISTRATION (FDA)

Berinert is a plasma-derived C1 esterase Inhibitor [human] FDA-labeled for the treatment of acute abdominal, facial, or laryngeal attacks of hereditary angioedema (HAE) in adult and adolescent patients. The safety and efficacy of Berinert for prophylactic therapy have not been established.¹
Cinryze is a C1 esterase inhibitor [human] FDA-labeled for routine prophylaxis against angioedema attacks in adolescent and adult patients with hereditary angioedema (HAE).³

Kalbitor is a plasma kallikrein inhibitor FDA-labeled for treatment of acute attacks of hereditary angioedema (HAE) in patients 12 years of age and older.²

Ruconest is a C1 esterase inhibitor [recombinant] FDA-labeled for the treatment of acute attacks in adult and adolescent patients with hereditary angioedema (HAE).¹⁹ The effectiveness of Ruconest has not been established in HAE patients with laryngeal attacks.

**BACKGROUND**

**C1 Esterase Inhibitor**

**Human**

Cinryze and Berinert are highly purified, pasteurized, nanofiltered, lyophilized C1 inhibitor products prepared from large pools of human plasma from US donors.¹,³,¹¹,¹³ C1 inhibitor is a normal constituent of human blood and is one of the serine proteinase inhibitors (serpins). The primary function of C1 inhibitor is to regulate the activation of the complement and intrinsic coagulation (contact system) pathway. C1 inhibitor also regulates the fibrinolytic system.

HAE patients have low levels of endogenous or functional C1 inhibitor. Although the events that induce attacks of angioedema in HAE patients are not well defined, it is thought that increased vascular permeability and the clinical manifestation of HAE attacks are primarily mediated through contact system activation. Suppression of contact system activation by C1 inhibitor through the inactivation of plasma kallikrein and factor XIIa is thought to modulate this vascular permeability by preventing the generation of bradykinin, the main mediator of HAE attacks.

Cinryze increases antigenic and functional plasma levels of C1 inhibitor, thereby increasing the deficient C1 inhibitor.

Berinert is a human plasma C1 esterase inhibitor to be reconstituted for intravenous administration. Administration of Berinert to patients with C1 esterase inhibitor deficiency replaces the missing or malfunctioning protein in patients.

**Recombinant**

Ruconest is a serine protease inhibitor which suppresses complement and contact pathway systems by irreversibly binding to and inactivating proteases such as kallikrein and factor XIIa.¹⁵,¹⁹ These actions on the contact pathway system prevent the formation of bradykinin, and regulate vascular permeability that is thought to contribute to hereditary angioedema attacks.

**Human Plasma Kallikrein Inhibitor [human]**

Kalbitor is a human plasma kallikrein inhibitor for injection for subcutaneous use to treat symptoms hereditary angioedema (HAE).²,¹² (HAE) is a rare genetic disorder caused by mutations to C1-esterase-inhibitor (C1-INH) located on Chromosome 1 1q and inherited as an autosomal dominant trait. HAE is characterized by low levels of C1-INH activity and low levels of C4. C1-INH functions to regulate the activation of the complement and intrinsic coagulation (contact system pathway) and is a major endogenous inhibitor of plasma kallikrein. The kallikrein-kinin system is a complex proteolytic cascade involved in the initiation of both inflammatory and coagulation pathways. One critical aspect of this pathway is the conversion of High Molecular Weight (HMW) kininogen to bradykinin by the protease plasma kallikrein. In HAE, normal regulation of plasma kallikrein activity and the classical complement cascade is therefore not present. During attacks, unregulated activity of plasma kallikrein results in excessive bradykinin generation. Bradykinin is a vasodilator which is thought by some to be responsible for the characteristic HAE symptoms of localized swelling, inflammation, and pain. Kalbitor is a potent (Ki = 25 pM), selective, reversible inhibitor of plasma kallikrein. Kalbitor binds to plasma kallikrein and blocks its binding site, inhibiting the conversion of HMW kininogen to bradykinin.

By directly inhibiting plasma kallikrein, Kalbitor reduces the conversion of HMW kininogen to bradykinin and thereby treats symptoms of the disease during acute episodic attacks of HAE.

**APPLICABLE CODES**

The following list(s) of procedure and/or diagnosis codes is provided for reference purposes only and may not be all inclusive. Listing of a code in this policy does not imply that the service described by the code is a covered or non-covered health service. Benefit coverage for health services is determined by the member specific benefit plan document and applicable laws that may require coverage for a specific service. The inclusion of a code does not imply any right to reimbursement or guarantee claim payment. Other Policies and Coverage Determination Guidelines may apply.
In a phase 3, randomized, placebo-controlled trial, researchers evaluated the efficacy and safety of recombinant human C1 inhibitor (rhC1INH) [Ruc芬est] for repeated treatment of acute attacks of hereditary angioedema (HAE). Patients with HAE attacks were treated with an intravenous 50-U/kg dose of rhC1INH with an option for an additional dose of 50 U/kg based on clinical response. Patients used a 100-mm visual analogue scale (VAS) to assess time to beginning of relief. Safety evaluation was based on the clinical laboratory results and adverse events. Sixty-two patients were treated for 168 attacks (range, 1-8 attacks per patient). A total of 90% of the attacks were treated with a single 50-U/kg dose of rhC1INH. Median times to beginning of symptom relief for the first 5 attacks ranged from 37 to 67 minutes. More than 90% of attacks responded within 4 hours after treatment with rhC1INH. Thirty-nine patients (63%) reported at least 1 treatment-emergent adverse event, with most events rated mild to moderate. There were seven severe treatment-emergent adverse events reported, however, all were considered to be unrelated to rhC1INH treatment. The results of this open-label extension support continued efficacy of rhC1INH after repeated treatments for subsequent HAE attacks. Additionally, there were no increases in adverse event reporting after repeated exposure to rhC1INH.

In a phase 3, randomized, placebo-controlled trial, researchers evaluated the efficacy and safety of recombinant human C1 inhibitor (rhC1INH 50 IU/kg to maximum 4,200 IU/treatment) versus placebo in patients with hereditary angioedema (HAE) experiencing peripheral, abdominal, facial, and/or oropharyngeal laryngeal attacks. Seventy-five patients were randomized (3:2) to rhC1INH (n = 44) or placebo (saline; n = 31). Efficacy was assessed by patient responses on both a Treatment Effect Questionnaire (TEQ) and visual analog scale (VAS). Safety also was evaluated. Median (95% CI) time to beginning of symptom relief at the primary attack location was 90 minutes (range: 61-150) in rhC1INH-treated patients vs 152 minutes in placebo-treated patients (p=0.031) based on the TEQ and 75 minutes (range: 60-105) vs 303 minutes (range: 81-720, p=0.003) based on a VAS decrease of at least 20 mm. Median time to minimal symptoms was 303 minutes (range: 240-720) in rhC1INH-treated patients vs 483 minutes (range: 300-1,440) in placebo-treated patients based on the TEQ (p=0.078) and 240 minutes (range: 177-270) vs 362 minutes (p=0.005), based on an overall VAS less than 20 mm. No thromboembolic events, anaphylaxis, or neutralizing antibodies were reported with rhC1INH treatment. Consistent with previous trial results, relief of symptoms of HAE attacks was achieved faster, and safely, with rhC1INH compared with placebo.

**Berinert**

Utilizing data obtained during IMPACT-2, researchers performed a retrospective subgroup analysis to evaluate if repeated treatment with C1 esterase inhibitor (C1-INH) concentrate [Berinert] dosed at 20 U/kg for successive attacks had any effect on the treatment response to C1-INH concentrate. Fifty-seven patients were studied in IMPACT-2,
and of those 57 patients, 18 patients (32%) were treated with C1-INH concentrate for at least 15 attacks each over a mean duration of 34 months (range, 10-51 months). Of the 18 patients treated for ≥ 15 attacks, 7 patients (39%) had between 15 and 25 HAE attacks and 11 patients (61%) had 25 HAE attacks. The distribution of body locations and the intensity of HAE attacks were similar for each of the first 15 attacks and subsequent attacks. Repeated treatment had no systematic effect on the frequency of HAE attacks, the intensity of HAE attacks, the time to onset of symptom relief, or the time to complete resolution of HAE symptoms (the median of individual linear regression coefficients was not statistically significantly different from 0). Additionally, repeated treatment with C1-INH concentrate is not associated with development of inhibitory anti-C1-INH antibodies. The authors concluded that treatment with 20 U/kg of C1-INH concentrate provided consistent response in patients treated for multiple successive HAE attacks regardless of location.

In a prospective, open-label, uncontrolled, multicenter extension study of IMPACT-1, safety and efficacy of long-term treatment with C1 esterase inhibitor concentrate (C1-INH) [Berinert] 20 U/kg was evaluated in subsequent hereditary angioedema (HAE) attacks at any body location (IMPACT-2). Patients were eligible if they had any type of HAE attack and had previously participated in IMPACT-1 for which they had to be at least 6 years of age with HAE type I or II. The primary efficacy endpoint was the time from start of treatment to onset of symptom relief, analyzed on a per-patient and per-attack basis. The secondary endpoint was the patient-reported time to complete resolution of HAE symptoms. Adverse events, vital signs, viral safety and anti-C1-INH antibodies were measured to evaluate safety. During a median study duration of 24 months (range: 0-51 months), 1085 attacks were treated in 57 patients (10-53 years of age). In the per-patient analysis, the median time to onset of symptom relief on any body location was 0.46 h (shortest for abdominal attacks: 0.39 h compared to 0.44 h for laryngeal, 0.43 h for peripheral and 0.48 h for facial); the median time to complete resolution of symptoms was 15.5 h (shortest for laryngeal attacks: 5.8 h compared to 12.8 h for abdominal, 22.7 h for peripheral and 26.6 h for facial attacks). Demographic factors, type of HAE, intensity of attacks, time to treatment, and use of androgens and presence of anti-C1-INH antibodies had no clinically relevant effect on the efficacy outcomes. There were no treatment-related safety concerns. No inhibitory anti-C1-INH antibodies were detected in any patient. Authors conclude that a single dose of 20 U/kg C1-INH concentrate is safe and provides reliable efficacy in the long-term treatment of successive HAE attacks at any body location.

In a randomized, double-blind, placebo-controlled trial, the efficacy of pasteurized C1 esterase inhibitor concentrate (C1-INH) [Berinert] was studied in 125 patients at least 6 years of age with type I or type II hereditary angioedema (HAE) experiencing an acute abdominal or facial attack presenting for treatment within 5 hours of the attack (IMPACT-1). Patients were randomized to receive a single intravenous infusion of C1-INH 10 U/kg (n=40), C1-INH 20 U/kg (n=43) or placebo (n=42). The primary endpoint was time from start of treatment to onset of symptom relief, as determined by patient responses to a standard question posed at appropriate time intervals for as long as 24 hours after the start of treatment. Secondary outcomes were time to complete resolution of all HAE symptoms, proportion of patients with worsened intensity of angioedema symptoms between 2 and 4 hours after treatment, and number of vomiting episodes within 4 hours. Median time to onset of relief was significantly shorter with C1-INH concentrate at a dose of 20 U/kg than with placebo (0.5 vs 1.5 hours; p=0.0025), whereas with C1-INH 10 U/kg, the time to onset of relief was only slightly shorter than with placebo (1.2 vs 1.5 hours; p=0.2731). The reduction in time to onset of relief was greatest for severe attacks (0.5 vs 13.5 hour) as compared to placebo. Median time to onset of symptom relief was relatively short for abdominal attacks (placebo, 1.3 hours; C1-INH 10 U/kg, 1.2 hours; C1-INH 20 U/kg, 0.5 hours) compared with facial attacks (placebo, 24.0 hours; C1-INH 10 U/kg, 1.3 hours; C1-INH 20 U/ kg, 0.9 hours). Secondary outcomes consistently supported the efficacy of the 20 U/kg dose. No difference in treatment effect in terms of time to onset of symptom relief could be confirmed by stratified analysis when comparing the efficacy of C1-INH 20 U/kg in facial and abdominal attacks, and in moderate and severe attacks. C1 esterase inhibitor concentrate was safe and well tolerated. No seroconversions were observed for HIV, hepatitis virus, or human B19 virus. Researchers conclude that C1-INH 20 U/kg administered intravenously is a safe and effective treatment for rapidly alleviating symptoms of abdominal and facial HAE attacks.

Cinryze

In a Phase 3, open-label study, safety and efficacy of repeat use of nanofiltered C1 esterase inhibitor (human) [C1 INH-nf, Cinryze] for treatment of acute attacks of hereditary angioedema (HAE) was evaluated. Patients age 1 year or older who were included if they had previously enrolled or participated in LEVP2005-1/A and/or LEVP2005-1B trials. Patients received 1,000 units of C1 INH-nf administered intravenously. If there was no response to treatment 60 minutes after the first dose, a second 1,000 U dose could be administered. Primary endpoints included number of HAE attacks treated with C1 INH-nf and percent of HAE attacks with substantial symptom relief within 4 hours of treatment. Secondary endpoints measured included time to beginning of substantial relief of acute attack symptom after initial and multiple treatments, and the effects of treatment on antigenic and functional levels of C1 inhibitor and on C4 levels. Safety was monitored through adverse event reporting, vital signs measurements, and laboratory testing. A total of 113 patients were enrolled in the study and received 885 doses of C1 INH-nf. A total of 609 HAE attacks were treated with C1 INH-nf, and the numbers of attacks achieving unequivocal relief of the defining symptom within 1 and 4 hours after the initial dose were 412 (68%) and 529 (87%), respectively. Of 101 patients treated for
an attack during the study period, 80 achieved unequivocal relief of their first attack within 4 hours after initial C1 INH-nf dose (response rate, 79%); median time to the beginning of unequivocal relief was 0.75 hour. C1 INH-nf was safe and well tolerated. Researchers conclude that C1 INH-nf is safe and efficacious for short-term treatment of HAE attacks.

Efficacy of nanofiltered C1 inhibitor concentrate (Cinryze) in treatment of acute attacks of hereditary angioedema (HAE) was evaluated in a randomized, double-blind, placebo-controlled trial (n=68) [LEVVPN051/A].7 Patients aged 6 years and older with HAE due to C1 inhibitor deficiency (low C4 level, normal C1q level, and a low antigenic or functional C1 inhibitor level or a mutation in the C1 inhibitor gene which causes hereditary angioedema) who presented to the study site within 4 hours of a moderate or severe acute attack involving the abdomen, face, or external genitalia were eligible for study enrollment. Patients presenting with laryngeal angioedema were excluded. Eligible patients were randomized to receive C1 inhibitor concentrate 1000 units (n=35) or placebo (n=33) given as an IV push over 10 minutes (min). A second dose of study medication (permitted if symptoms were not absent or better after 60 min) was given in 23 patients in the C1 inhibitor concentrate arm and 28 patients in the placebo arm and all patients in the placebo arm who did not have significant symptom improvement after 4 hours received open-label C1 inhibitor concentrate. The primary end point was the time from administration of the study drug to unequivocal relief of symptoms at the defining site (i.e., the first of three consecutive reports of improvement). Secondary end points included the percentage of subjects who had an onset of unequivocal relief within 4 hours after treatment, the time to complete resolution of the attack (i.e., all symptoms of swelling absent), and the effects of treatment on antigenic and functional levels of C1 inhibitor and on C4 levels. Estimated median time to onset of unequivocal relief (primary endpoint) was 2 hours in the C1 inhibitor concentrate arm and longer than 4 hours in the placebo arm (estimated success rate ratio, 2.41; 95% CI, 1.17 to 4.95; p=0.02); additionally, the onset of unequivocal relief was achieved within 4 hours in 21 (60%) and 14 (42%) patients in each study arm, respectively (p=0.06). The median time to complete symptom resolution was 12.3 hours in the C1 inhibitor concentrate arm and 25 hours in the placebo arm (p=0.004). Antigenic and function C1 inhibitor levels significantly increased in the C1 inhibitor concentrate arm compared with the placebo arm (p<0.001); however, C4 levels were not significantly different between the 2 study arms during the first 4 hours. Injection-site rash was reported in 1 patient in the C1 inhibitor concentrate arm. Following treatment with nanofiltered C1 inhibitor concentrate for an acute attack, the median time to response was 30 min in 82 patients with HAE (median number of attacks per patient, 3; range, 1 to 57 attacks) in an open-label extension trial (median follow-up of 11 months). Additionally, 93% of attacks responded within 4 hr after C1 inhibitor concentrate treatment. Researchers conclude that treatment with nanofiltered C1 inhibitor concentrate shortens duration of acute attack compared with placebo in patients with HAE.

Kalbitor
In order to assess the potential risk for attack rebound or relapse following ecallantide treatment, Bernstein et al. conducted a post-hoc analysis of the study population from two pivotal double-blind, placebo-controlled ecallantide studies, EDEMA3-DB and EDEMA4.18 Measurement of symptoms was assessed by treatment outcome score (TOS), mean symptom complex severity (MSCS) score, and global response. Patients with improvement at 4 hours post-dosing in all three measures followed by any sign of worsening at 24 hours were considered to show potential rebound if worsening was beyond baseline or were considered to show potential relapse if not beyond baseline. Likelihood of rebound or relapse was determined by the number of measures showing worsening and the magnitude of worsening. Patients receiving placebo who met the criteria for rebound/relapse were utilized for descriptive comparison only. At 4 hours, improvement in at least one of three efficacy measures was seen in 51 (72.9%) ecallantide-treated and 37 (52.1%) placebo-treated patients (p=0.01). Improvement in all three measures (TOS, MSCS score, and global response) was seen in 42 (60%) ecallantide-treated and 26 (37%) placebo-treated patients (p<0.01). Of the 42 ecallantide-treated patients showing measured improvement, a total of 9 (21.4%) showed signs of worsening at 24 hours and were thus considered potential rebound/relapse. Of the nine ecallantide-treated patients with signs of worsening at 24 hours, none were likely to rebound, one was assessed as possible rebound, one as likely relapse, and two as possible relapse. No patient with potential rebound/relapse experienced new symptoms after dosing. Medical intervention was required in one ecallantide-treated patient (likely relapse, patient received danazol for an abdominal attack). Recognizing that relapse was observed in a small proportion of patients and there was little evidence of rebound, the authors concluded that ecallantide was efficacious for treating acute HAE attacks.

Efficacy and safety of ecallantide in the treatment of acute hereditary angioedema (HAE) attacks was evaluated in a double-blind, placebo-controlled study (EDEMA-4).8 Patients with moderate to severe HAE attacks were randomized 1:1 to receive subcutaneous ecallantide 30mg (n=48) or placebo (n=48). Patients aged 10 years and older with documented evidence of type I or II HAE who presented within 8 hours of a moderate to severe HAE attack affecting any anatomical location were included. The primary efficacy end point was change from baseline in mean symptom complex severity score (MSCS) 4 hours after dosing. Secondary end points included treatment outcome score (TOS) 4 hours after dosing and maintenance of significant overall improvement through 24 hours. Mean (SD) change from baseline in MSCS score 4 hours after dosing was significantly greater with ecallantide use (-0.8 [SD=0.6]) compared with placebo use (-0.4 [SD=0.8]) (p=0.01 comparing distributions). Ecallantide therapy was also associated with a significantly larger mean (SD) TOS 4 hours after dosing vs placebo use (ecallantide: 53.4 [SD=49.7]; placebo: 8.1

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Efficacy of ecallantide in patients (n=72) with hereditary angioedema presenting with an acute attack was evaluated in a double-blind, placebo-controlled trial (EDEMA-3). Patients at least 10 years of age with an acute attack were randomly assigned, in a 1:1 ratio, to receive subcutaneous ecallantide 30 mg (n=36) or placebo (n=36) and observed for at least 4 hours after administration. Symptoms were assessed every 15 minutes for the first 2 hours, every 30 minutes for the next 2 hours, and finally at 24 hours. Two measures of patient-reported outcomes were used to assess the response: treatment outcome scores, which range from +100 (designated in the protocol as significant improvement in symptoms) to -100 (significant worsening of symptoms), and the change from baseline in the mean symptom complex severity score, which range from +2 (representing a change from mild symptoms at baseline to severe symptoms after) to -3 (representing a change from severe symptoms at baseline to no symptoms after). The primary trial end point was the treatment outcome score 4 hours after study-drug administration and secondary end points included the change from baseline in the mean symptom complex severity score at 4 hours and the time to significant improvement. At 4 hours, the median treatment outcome score was 50.0 in the ecallantide group and 0.0 in the placebo group (interquartile range [IQR], 0.0 to 100.0 in both groups; p=0.004). The median change in the mean symptom complex severity score for 4 hours reported was -1.00 (IQR, -1.50 to 0.00) with ecallantide, versus -0.50 (IQR, -1.00 to 0.00) with placebo (p=0.01). Median time to significant improvement was 165 minutes with ecallantide versus more than 240 minutes with placebo (p=0.14). There were no deaths, treatment-related serious adverse events, or withdrawals owing to adverse events. Researchers conclude that at four hours after administration of ecallantide or placebo for acute attacks of angioedema in patients with HAE, patient-reported treatment outcome scores and mean symptom complex severity scores were significantly better with ecallantide than with placebo.

### HAE (prophylaxis)

#### Cinryze

Zuraw et al. conducted an open-label, multicenter extension study to assess the safety and efficacy of prophylactic nanofiltered C1-inhibitor (C1INH-nf) [Cinryze] in a large cohort of patients with hereditary angioedema. A total of 146 patients (age range, 3-82 years) with hereditary angioedema received prophylactic C1INH-nf for up to 2.6 years in centers throughout the United States. The primary efficacy endpoint for each patient was the number of angioedema attacks. Safety was evaluated by the number and severity of adverse events, and changes in clinical laboratory values (viral serology performed every 3 months) and vital signs. Patients experienced a 93.7% reduction in attacks while taking prophylactic C1INH-nf (0.19 attacks per month; interquartile range, 0.00-0.64) compared with the historical rate of attacks. The majority of patients (87.7%) reported an attack frequency of 1 or less attack per month during prophylactic C1INH-nf and 51 patients (34.9%) had no attacks during the study. Twice weekly dosing C1INH-nf resulted in a favorable response rate that varied from 95.7% at 30 days to 70.7% at 120 days. Once-weekly dosing resulted in a favorable response rate that varied from 69.3% at 30 days to 45.7% at 120 days. Twice-weekly dosing had a more favorable response rate than once-weekly dosing at each interval examined. Researchers noted that despite twice-weekly C1INH-nf dosing, 7.5% of patients experienced relatively frequent attacks. No clinical characteristics predicted the response to prophylactic C1INH-nf, including historical attack frequency. C1INH-nf was well tolerated. The authors concluded that prophylactic C1INH-nf treatment is highly effective and safe, and provides durable prophylaxis in the majority of patients with hereditary angioedema. Dosing of C1INH-nf at 1000 units twice weekly is supported by this study. Additionally, the authors commented that individual patients may benefit from further dose adjustment on the basis of response to therapy and individual treatment goals.

In a 24-week, randomized, double-blind, placebo-controlled, cross-over trial (n=22), prophylaxis with nanofiltered C1 inhibitor concentrate (Cinryze) was evaluated in preventing attacks of hereditary angioedema (HAE) [LEV2005-1/B]. Patients aged 6 yr and older with HAE due to C1 inhibitor deficiency who had been randomized to receive C1 inhibitor concentrate for the treatment of acute attacks in a double-blind, placebo-controlled trial and who had a history of 2 or more attacks per month were eligible for enrollment. Eligible patients received either C1 inhibitor concentrate 1000 units (n=11) or placebo (n=11) every 3 to 4 days for 12 weeks and then switched to the other therapy for the next 12 weeks. The primary efficacy end point was the number of attacks of angioedema during each treatment period. Secondary end points included the average severity of attacks, average duration of attacks, number of open-label injections of C1 inhibitor, and total number of days of swelling. The average number of attacks in a 12-week period (primary endpoint) was 6.26 attacks during the C1 inhibitor concentrate prophylaxis period and 12.73 attacks during the placebo period (attack rate difference, 6.47 attacks; 95% CI, 4.21 to 8.73 attacks; p<0.001). For attacks which occurred during the C1 inhibitor concentrate prophylaxis period compared with the placebo period, the mean severity score (evaluated using a 3-point scale: mild=1; moderate=2; severe=3) was significantly lower (1.3 +/- 0.85 vs 1.9 +/- 0.36, respectively; p<0.001) and the attack duration was significantly lower (1.3 +/- 0.85 vs 1.9 +/- 0.36, respectively; p<0.001).
shorter (2.1 +/- 1.13 vs 3.4 +/- 2.39 days, respectively; p=0.002). Additionally, fewer rescue C1 inhibitor concentrate injections were required (4.7 +/- 8.66 vs 15.4 +/- 8.41 injections; p<0.001) and fewer days of swelling were reported (10.1 +/- 10.73 vs 29.6 +/- 16.9 days; p<0.001) during the C1 inhibitor concentrate prophylaxis period compared with the placebo period. Adverse events possibly associated with C1 inhibitor concentrate use included 1 report each of pruritus and rash, lightheadedness, and fever. Researchers conclude that nanofiltered C1 inhibitor concentrate significantly reduced the number of attacks compared with placebo in patients with HAE.

**Professional Societies**

**Canadian Hereditary Angioedema Guidelines (2014)**

The Canadian Hereditary Angioedema Guideline Committee, under the auspices of the Canadian Hereditary Angioedema Network/Réseau Canadien d'angioédème héréditaire (CHAEN/RCAH) published guidelines to provide graded recommendations for the management of patients in Canada with HAE. Their recommendations for the treatment of HAE include:

- C1 esterase inhibitors (C1-INH), icatibant, and ecallantide are effective therapy options for the treatment of acute attacks.
- Short-term prophylaxis should be considered prior to known patient-specific triggers and for any medical, surgical or dental procedures.
- Long-term prophylaxis may be appropriate for some patients to reduce frequency, duration and severity of attacks.
- Attenuated androgens are effective for long-term prophylaxis in some patients.
- Plasma-derived C1-INH is effective for long-term prophylaxis in some patients.
- Anti-fibrinolytics are effective for long-term prophylaxis in some patients.
- All patients should be trained on self-administration of HAE-specific therapies if they are suitable candidates. If patients cannot self-administer therapy, provisions should be made to ensure timely access to all appropriate therapies.

**US Hereditary Angioedema Association Medical Advisory Board 2013 Recommendations for the Management of Hereditary Angioedema Due to C1 Inhibitor Deficiency (2013)**

In 2013, the US HAEA partnered with its Medical Advisory Board (MAB) to write and publish a set of guidelines for the treatment of hereditary angioedema. Recommendations include:

- The overall goals of HAE treatment are to reduce morbidity and mortality, and to achieve these goals, an individualized comprehensive management plan must be developed and implemented.
- Because of the complexity and variability of HAE and treatment, it is strongly recommended that every patient with HAE be followed up by a physician who is (1) knowledgeable about the condition, (2) experienced in managing patients with HAE, and (3) familiar with all HAE treatment options.
  - These physicians should work with their patients to assure that a defined and individualized HAE management plan is established and should also actively coordinate the patient's care with other health care providers.
- All attacks, irrespective of location, should be considered for treatment as soon as they are clearly recognized.
- Androgens should not be used in patients who express a preference for an alternative therapy and should not be required to fail androgen therapy as a prerequisite to receiving prophylactic C1INH concentrate.

**A Focused Parameter Update: Hereditary Angioedema, Acquired C1 Inhibitor Deficiency, and Angiotensin-converting Enzyme Inhibitor-associated Angioedema**

In 2013, The Joint Task Force on Practice Parameters (JTF) representing the American Academy of Allergy, Asthma & Immunology (AAAAI); the American College of Allergy, Asthma & Immunology (ACAAI); and the Joint Council of Allergy, Asthma and Immunology, conducted a systematic literature review in conjunction with consensus expert opinion and work-group identified supplementary documents and developed practice parameters that provide a comprehensive approach for the assessment and management of angioedema, with a focus on C1 inhibitor (C1INH) deficiency syndromes and angioedema associated with angiotensin-converting enzyme inhibitors. Recommendations include:

- Optimal management of HAE depends on early identification of patients. (D)
- Epinephrine, corticosteroids, and antihistamines are not efficacious and not recommended for the treatment of HAE. (C)
- Fresh frozen plasma is often effective in abrogating HAE attacks; however, fresh frozen plasma might acutely exacerbate some attacks, and for this reason, caution is required. (D)
- Management of HAE attacks can involve symptomatic treatment based on the region of body swelling. (C)
- All patients with HAE should have access to an effective, on-demand HAE-specific agent. Evidence from double-blind, placebo-controlled randomized clinical trials demonstrates the efficacy and safety of treatment of HAE attacks with C1INH concentrates, a plasma kallikrein inhibitor, or a bradykinin B2 receptor antagonist (A).
- Short-term prophylaxis can be achieved by using fresh frozen plasma, C1INH replacement, or short-term, high-dose anabolic androgen therapy. (B)
• Treatment with low-to-moderate doses of anabolic androgens provides effective and relatively safe long-term HAE prophylaxis for many patients. (B)
• Treatment with antifibrinolytic agents provides somewhat effective and relatively safe long-term HAE prophylaxis but is generally less effective than androgens. (B)
• Treatment with replacement plasma-derived C1INH provides effective and safe long-term HAE prophylaxis. (A)
• The novel agents for treatment of patients with C1INH deficiency syndromes are more costly than alternative treatment with attenuated androgens. Formal studies of cost utility and cost-effectiveness are required to aid providers in the management of patients with C1INH deficiency syndromes. (D)

Strength of recommendation:
A: Directly based on category I evidence
B: Directly based on category II evidence or extrapolated recommendation from category I evidence
C: Directly based on category III evidence or extrapolated recommendation from category I or II evidence
D: Directly based on category IV evidence or extrapolated recommendation from category I, II, or III evidence
LB: Laboratory based
NR: Not rated


The goal of acute treatments is to resolve angioedema symptoms as quickly as possible. Recommendations for treatment include:
• Any angioedema attack in HAE patients can become disabling and/or life-threatening: therefore, all patients with HAE owing to C1-INH deficiency, even if still asymptomatic, should have access to at least one of the specific medicines, plasma-derived and recombinant C1-INHs, icatibant, and ecallantide.
• All attacks, irrespective of location, are eligible for treatment as soon as they are clearly recognized by the patient, ideally before visible or disabling symptoms develop.

The goal of prophylactic treatment is either to reduce the likelihood of swelling in those patients undergoing a stressor or procedure likely to precipitate an attack (short-term prophylaxis) or to decrease the number and severity of angioedema attacks (long-term prophylaxis). Recommendations are as follows:
• Long-term prophylactic treatment is appropriate for patients in whom on-demand acute treatment is not adequate to minimize the suffering related to the disease.
• Plasma-derived C1-INH can be considered for long-term prophylactic treatment without exclusion for all groups of patients.
• Regimens of prophylactic plasma-derived C1-INH should be individualized to optimize clinical response.


In 2012, the World Allergy Organization (WAO) HAE International Alliance developed the first global guideline for the management of HAE. The recommendations for the treatment of type 1 and 2 HAE include:
• All attacks that result in debilitation/dysfunction and/or involve the face, the neck, or the abdomen should be considered for on-demand treatment. Treatment of attacks affecting the upper airways is mandatory. Evidence grade: D, strength of recommendation: strong.
• Attacks are treated as early as possible. Evidence grade: D, strength of recommendation: strong.
• HAE attacks are treated with C1-INH, ecallantide, or icatibant. Evidence grade: A, strength of recommendation: strong.
• Intubation or tracheotomy is considered early in progressive upper airway edema. Evidence grade: D, strength of recommendation: strong.
• Patients with attacks receive adjuvant therapy when indicated (pain management, intravenous fluids, and supportive care), but specific therapies should be used without delay when indicated. Evidence grade: D, strength of recommendation: strong.
• Oral antifibrinolytics are not to be used as on-demand treatment. Evidence grade: A, strength of recommendation: strong.
• All patients should have on-demand treatment for 2 attacks. Evidence grade: D, strength of recommendation: strong.
• All patients should carry their on-demand treatment at all times. Evidence grade: D, strength of recommendation: strong.
• The administration of short-term prophylaxis should be considered before surgeries, especially dental/intraoral surgery, where endotracheal intubation is required, where upper airway or pharynx is manipulated, and before bronchoscopy or endoscopy. Evidence grade: D, strength of recommendation: strong.
• The preferred on-demand therapy for HAE-1/2 attacks in children is plasma derived C1-INH. Evidence grade: D, strength of recommendation: strong.
• During pregnancy and lactation, pdC1-INH is the preferred therapy. Evidence grade: D, strength of recommendation: strong.
• All patients with HAE should have at least 1 annual assessment by an HAE specialist. Evidence grade: D, strength of recommendation: strong.
• Hepatitis A and B vaccination should be administered to HAE-1/2 patients receiving blood products, including pdC1-INH. All patients should receive influenza vaccine. Evidence grade: D, strength of recommendation: strong.

Evidence grades:
A. Randomized, double-blind, clinical trial of high quality (eg, sample size calculation, flow chart of patient inclusion, intention-to-treat analysis, sufficient sample size).
B. Randomized clinical trial of lesser quality (eg, only single blind and limited sample size: at least 15 patients per study arm).
C. Comparative trial with severe methodological limitations (eg, not blinded, very small sample size, and no randomization) or large retrospective observational studies.
D. Adapted from existing consensus document or statement based on expert opinion voting during consensus conference.

CENTERS FOR MEDICARE AND MEDICAID SERVICES

Medicare does not have a National Coverage Determination (NCD) that specifically addresses the use of Cinryze™, Berinert®, Ruconest® or Kalbitor® for the treatment of Hereditary Angioedema (HAE). Local Coverage Determinations (LCDs) do not exist at this time.

In general, Medicare covers outpatient (Part B) drugs that are furnished "incident to" a physician's service provided that the drugs are not usually self-administered by the patients who take them. See the Medicare Benefit Policy Manual (Pub. 100-2), Chapter 15, section 50 Drugs and Biologicals at http://www.cms.hhs.gov/manuals/Downloads/bp102c15.pdf. (Accessed May 24, 2016)

REFERENCES


**POLICY HISTORY/REVISION INFORMATION**

<table>
<thead>
<tr>
<th>Date</th>
<th>Action/Description</th>
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<tbody>
<tr>
<td>9/1/2016</td>
<td>Policy revised per annual review with no changes to the Coverage Rationale. Updated CMS Statement and References. Approved by the National Pharmacy &amp; Therapeutics Committee on 7/27/2016. Policy 2014D0044E archived.</td>
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<tr>
<td>10/1/2015</td>
<td>Policy revised for annual review with updates to the CMS statement, Benefits Considerations, Clinical Evidence, and References. Approved by the National Pharmacy &amp; Therapeutics Committee on 8/19/2015. Policy 2014D0044C archived.</td>
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<tr>
<td>11/1/2014</td>
<td>Policy revised for annual review to include trial/failure criteria for Cinryze and with updates to the following sections: Coverage Rationale, CMS, Benefits Considerations, Background, Clinical Evidence and References. Approved by National Pharmacy &amp; Therapeutics Committee on 8/20/2014. Policy 2013D0044B archived.</td>
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<tr>
<td>7/1/2013</td>
<td>Policy revised for annual review with updates to the following sections: Coverage Rationale, CMS, Benefits Considerations, Clinical Evidence and References. Approved by National Pharmacy &amp; Therapeutics Committee on 5/21/2013. Policy 2012D0044A archived.</td>
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<tr>
<td>11/14/2012</td>
<td>New policy drafted and approved by the National Pharmacy and Therapeutics Committee 5/15/2012.</td>
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