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## **Learning Objectives**



- Assess the clinical efficacy, durability in restoring hemostasis, and safety of new approaches for the management of hemophilia
- Develop a clinical and laboratory monitoring plan of the hemostatic status in patients receiving new therapies
- Implement shared decision making (SDM) strategies to better engage patients/caregivers with hemophilia in their treatment plan





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Hematology
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Hematology

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- ·Nashville, Tennessee



**Transformational Care** in Today's Therapeutic Landscape Mark W. Skinner, JD

## Therapeutic Evolution in a Nutshell

#### **Factor Replacement**

- Missing protein identified, purified, returned to PwH
- Viral inactivation
- Recombinant factor products
- Reduced volume

1900-1940s

Whole blood

- Better storage/portability
- [FVIII. FIX concentrates]

### Non-replacement, Rebalancing Therapies

- Metabolic manipulation
- Small molecules; SC dose
- Use with or without inhibitors
- [FVIII mimetics, anti-TFPI, anti-APC, AT-siRNA]

2017–2020s Nonfactor treatment

1990s

Recombinant FVIII/FIX

2010s-2020s Gene treatment

#### Gene Therapy

 Provides functional gene or edits abnormal gene

AAV

vectors

- Potential long-term cure or remission
- [FVIII and FIX products FDA approved]

1968

Commercially available FVIII

1950s–1960s
Fresh frozen plasma

1985 Viral inactivation

#### **Extended Half-life (EHL)**

2014

EHL factors

- Less frequent infusions
- Improved adherence
- Higher trough activity
- Better bleed protection
- [EHL rFVIII, EHL rFIX]

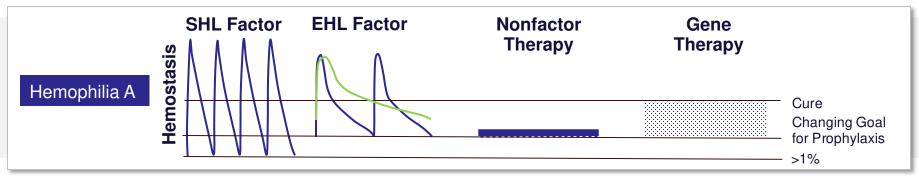
APC, activated protein C; AT, antithrombin; FIX, factor IX; FVIII, factor VIII; PwH, person with hemophilia; r, recombinant; RNA, ribonucleic acid; SC, subcutaneous; si, small interfering; TFPI, tissue factor pathway inhibitor.

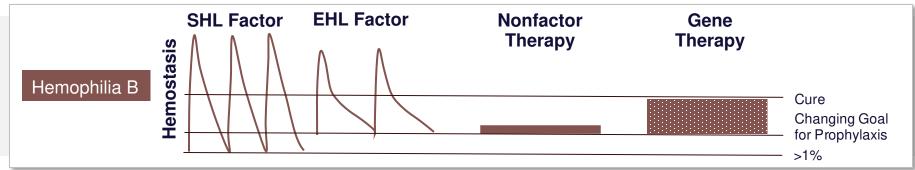
1964 Cryoprecipitate



# **Goal of Therapy Stable Hemostatic Levels**

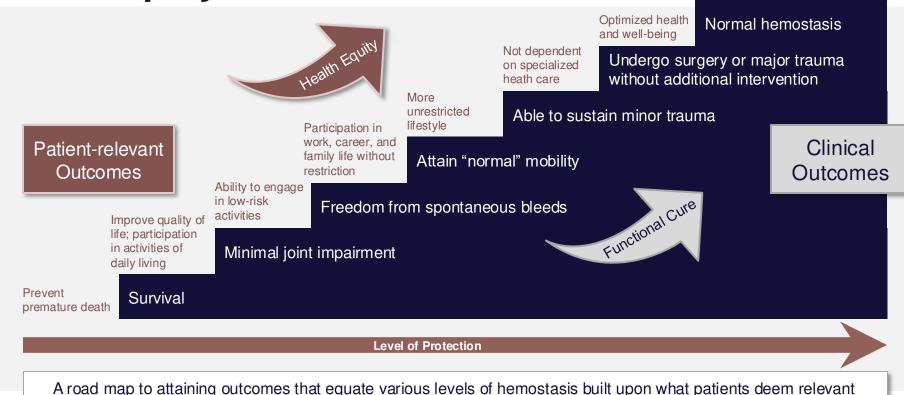








# **Achieving the Unimaginable Health Equity**



PART 1 **Mechanism of Action** and Efficacy of Novel Agents Amy D. Shapiro, MD

# Mechanism of Action Mimetics, Anti-TFPI, siRNA-AT







Which of the following novel therapeutics has reported a 15-fold increased potency compared to emicizumab, which may allow for lower dosing volumes?

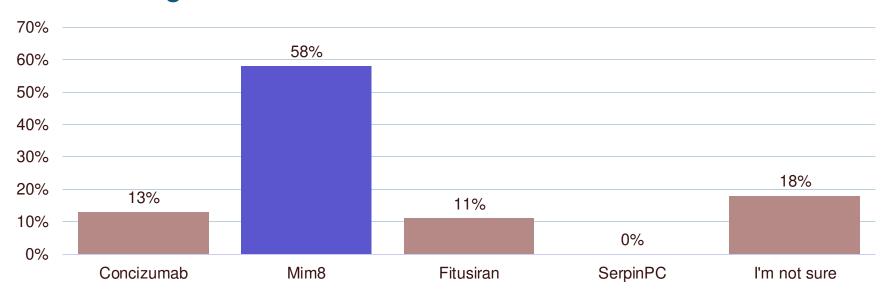
- A. Concizumab
- B. Mim8
- C. Fitusiran
- D. SerpinPC
- E. I'm not sure



## **Audience Response**

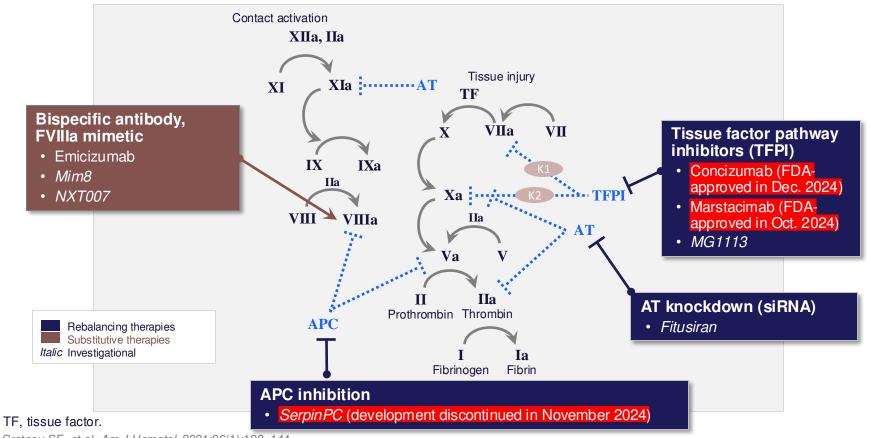


Which of the following novel therapeutics has reported a 15-fold increased potency compared to emicizumab, which may allow for lower dosing volumes?





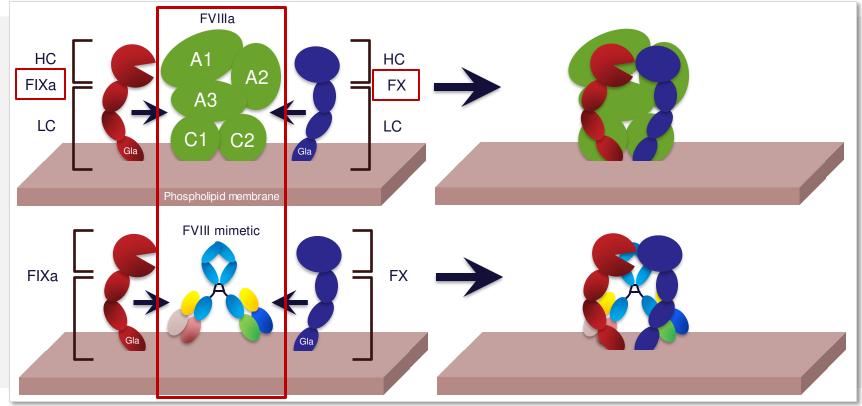
### **Novel Therapeutics to Treat Hemophilia A or B ± Inhibitors**



Croteau SE, et al. *Am J Hematol.* 2021;96(1):128–144.
Concizumab-mtci (package insert). Revised December 2024. www.accessdata.fda.gov/drugsatfda\_docs/label/2024/761315s000lbl.pdf.
Marstacimab-hncq (package insert). Revised October 2024. https://www.accessdata.fda.gov/drugsatfda\_docs/label/2024/761369s000lbl.pdf.
Lobo A. *Hemophilia News Today*. November 15, 2024. https://hemophilianewstoday.com/news/.



# Factor VIII vs FVIII Mimetics *MOA Comparison*

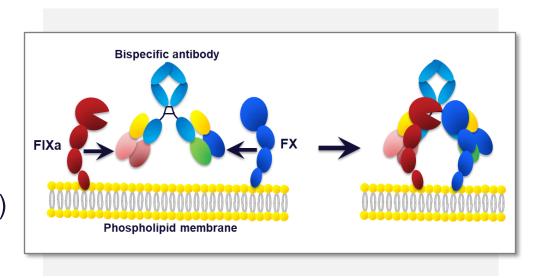


HC, high concentration; LC, low concentration; MOA, mechanism of action.

# FVIIIa Mimetics Bispecific Antibodies for Hemophilia A ± Inhibitors

#### **Emicizumab**

- FDA approved 2017–2018
- Subcutaneous (SC) administration
- Flexible dosing regimens
- Long half-life (26.9 ± 9.1 days)
- Decreased treatment burden, especially with inhibitors

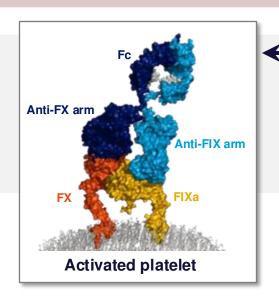








# FVIIIa Mimetics Bispecific Antibodies for Hemophilia A ± Inhibitors

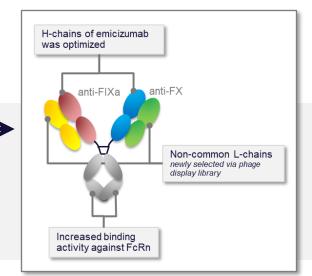


#### Mim8

- Currently in phase 3 trials
- Preclinical models: potency ~15-fold higher than emicizumab analog

#### **NXT007**

- Phase 1 clinical trial showed 10-week half-life
- Engineered and optimized based on emicizumab



Fc, fragment crystallizable; FcRn, neonatal crystallizable fragment receptor.

Sampei Z, et al. *PLoS One*. 2013;8(2):e57479. Lentz SR, et al. *J Thromb Haemost*. 2024;22:990–1000. Teranishi-Ikawa Y, et al. *J Thromb Haemost*. 2024;22:430–440.



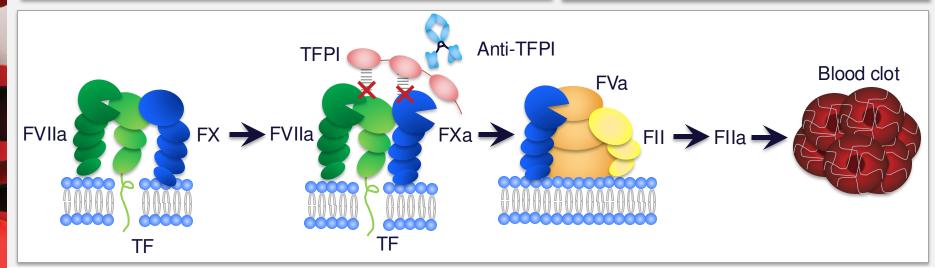
## **Anti-TFPIs for Hemophilia ± Inhibitors**

#### Concizumab

- Assessed in explorer trials
- Approved in Canada (FIX with an inhibitor)
- Approved in Japan (FVIII or FIX with inhibitors)
- Approved in the United States (Dec. 2024; FVIII or FIX with inhibitors)
- SC, once-daily, custom pen

#### Marstacimab

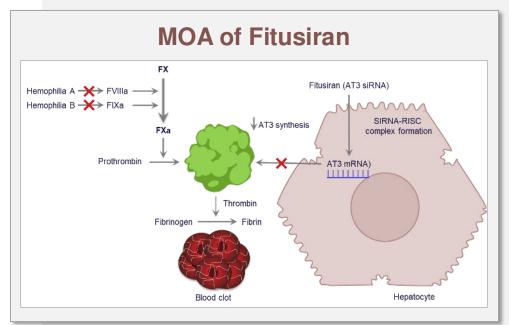
- Phase 3 BASIS trial
- Approved in the United States (Oct. 2024) and in the European Union (Nov. 2024)
- Once weekly SC dosing

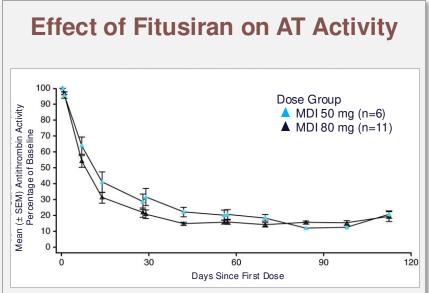


Matsushita T, et al. *N Engl J Med.* 2023;389:783–794. Keam SJ. *Drugs*. 2023;83(11):1053–1059. Concizumab-mtci (package insert). Updated December 2024. www.accessdata.fda.gov/drugsatfda\_docs/label/2024/761315s000lbl.pdf. Marstacimab-hncq (package insert). Updated October 2024. https://www.accessdata.fda.gov/drugsatfda\_docs/label/2024/761369s000lbl.pdf. Matino D, et al. *Blood*. 2023;142(Suppl 1):285. Chowdary P. *Drugs*. 2018;78(9):881–890.



# Fitusiran SC siRNA Targeting Antithrombin

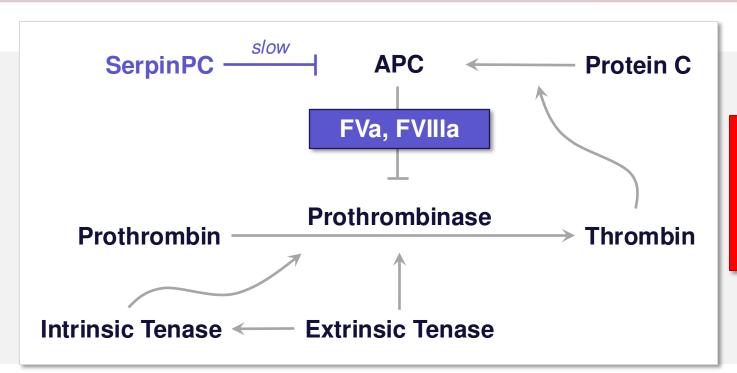






# SerpinPC (Recombinant Serine Protease Inhibitor)





November 2024
Update: Manufacturer elected to discontinue the clinical development of SerpinPC.

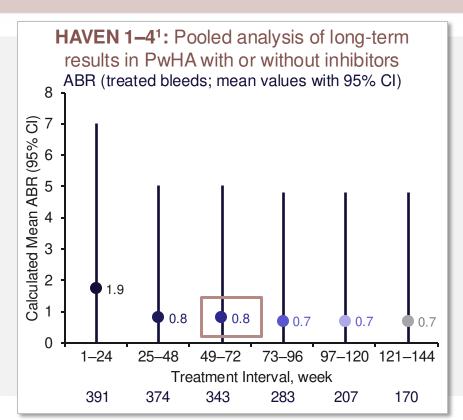


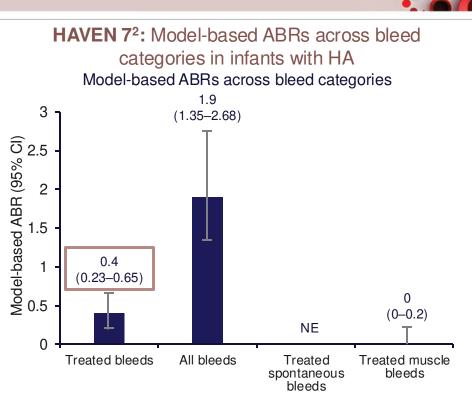
# Efficacy Summary Mimetics, Anti-TFPI, siRNA-AT



## **Emicizumab Phase 3**

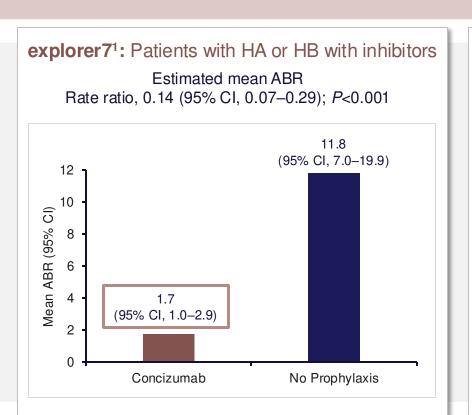






## **Concizumab Phase 3**





explorer8<sup>2</sup>: Spontaneous and traumatic bleeding episodes by HA/HB at the 56-week cut-off

	Concizumab Prophylaxis (arms 1–4)			
	Hemophilia A	Hemophilia B		
N in full analysis set		64		
f exposure in analysis data set	111.9	71.7		
Treated spontaneous and traumatic bleeding episodes				
Number of bleeding episodes		302		
Median (interquartile range)	1.7 (0.0–4.5)	2.8 (0.0-6.4)		
Mean (standard deviation)	3.9 (6.6)	6.4 (14.2)		
Min; max	0.0; 37.1	0.0; 91.3		
	f exposure in analysis data set neous and traumatic bleeding epoleeding episodes Median (interquartile range) Mean (standard deviation)	(arms 1–4)  Hemophilia A  s set 80  f exposure in analysis data set 111.9  neous and traumatic bleeding episodes  bleeding episodes 349  Median (interquartile range) 1.7 (0.0–4.5)  Mean (standard deviation) 3.9 (6.6)		

## **Marstacimab Phase 3**



#### BASIS<sup>1</sup>: Severe HA or moderately severe to severe HB, with or without inhibitors

Treatment Group	Factor Replacement Treatment Received during OP (n=116)	Marstacimab Prophylaxis during ATP (n=116)	Marstacimab Prophylaxis during LTE (n=87)	
OD	OD	Marstacimab	Marstacimab	
Mean ABRa (95% CI)	(n=33) 38.00 (31.03–46.54)	(n=33) 3.18 (2.09–4.85)	<b>(n=29)</b> 3.86 (2.02–7.37)	
Rate estimate (95% CI), P-value <sup>b</sup>	0.084 (0.059, 0.1	_		
RP	RP	Marstacimab	Marstacimab	
Mean ABRa (95% CI)	<b>(n=83)</b> 7.85 (5.09–10.61)	(n=83) 5.08 (3.40–6.77)	<b>(n=58)</b> 2.27 (1.40–3.67)	
Rate estimate (95% CI), P-value <sup>c</sup>	-2.77 (-5.37, -0.1	_		

<sup>&</sup>lt;sup>a</sup>Model-derived ABR

ATP, 12-month active treatment phase; LTE, long-term extension study; OD, on demand; OP, 6-month observation phase; RP, routine prophylaxis. Matino D, et al. *Blood.* 2023;142(Suppl 1):285.

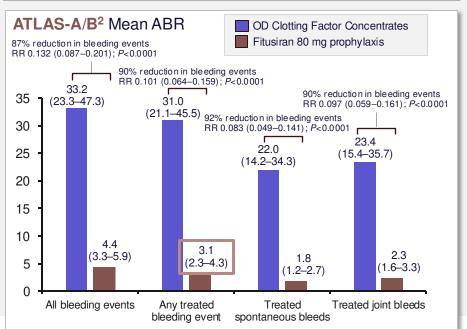


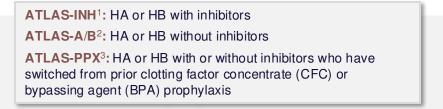
 $<sup>^{\</sup>rm b}P$ -values for the null hypothesis that the ration =  $\frac{1}{2}$  for all bleed related parameters

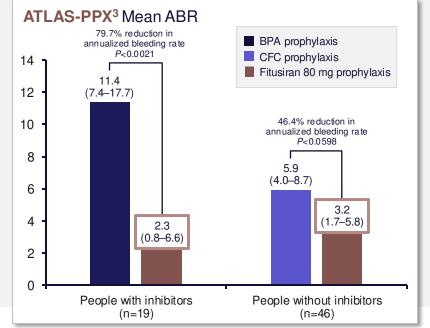
<sup>&</sup>lt;sup>c</sup>P-value if superiority met

### Fitusiran Phase 3

ATLAS-INH <sup>1</sup>	Bypassing Agent On-demand Group (n=19)	Fitusiran Prophylaxis Group (n=38)	<i>P-</i> value
Primary efficacy outcome			
Mean ABR estimated by negative binomial model	18.1 (10.6–30.8)	1.7 (1.0 –2.7)	<i>P</i> <0.0001
Observed median ABR	16.8 (6.7–23.5)	0.0 (0.0–1.7)	NR
Participants with zero bleeds	1 (5%)	25 (66%)	NR









<sup>&</sup>lt;sup>1</sup>Young G, et al. *Lancet*. 2023;401(10386):1427–1437.

<sup>&</sup>lt;sup>2</sup>Srivastava A, et al. *Lancet Haematol*. 2023;10(5):e322–e332. <sup>3</sup>Kenet G, et al. *HemaSphere*. 2023;7(S3):e643526e.

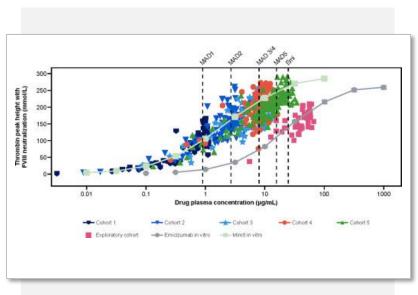
# Factor VIII Mimetics in Development Mim8 and NXT007



# Mim8 (FRONTIER 1/2)

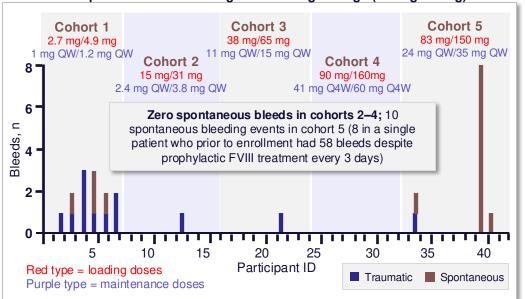


## Thrombin Peak Height vs Drug Plasma Concentration



## Observed Treated Bleeds from the Multiple Ascending Dose (MAD) Cohorts

Participants dosed according to their weight range (<60 kg/≥60 kg)



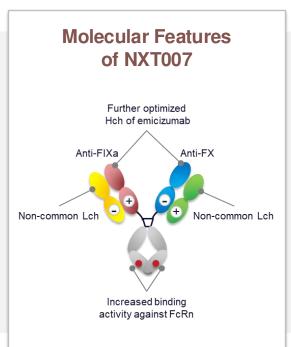
In vitro, Mim8 was 15× more potent than emicizumab

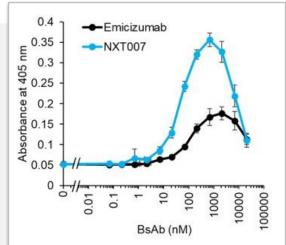


### **NXT007**

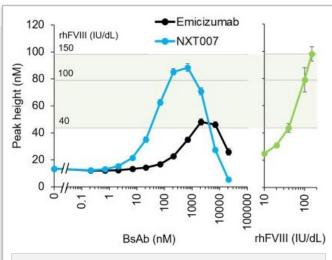
## A Bispecific Antibody That Mimics the Cofactor Function of FVIIIa







Effect of NXT007 or emicizumab on FIXa-catalyzed FX activation in an enzymatic assay using purified coagulation factors



Effect of NXT007, emcizumab, or rhFVIII on the peak height of thrombin generation using FVIII-deficient patient plasma



PART 2 **Thrombotic Risk Mitigation** and Coagulation Assays Allison D. Wheeler, MD, MSCI

## Thrombotic Risk Mitigation



## **Thromboembolic Events Reported during Trials**

- Emicizumab (HAVEN)
- Concizumab (explorer)
- Fitusiran (ATLAS)

Risk mitigation strategies put in place: dosing adjustments and guidance for management of mild/moderate bleeds



# Concizumab Thrombotic Events (3) in 3 Patients Resulting in Trial Pause



PwH	Age Range (years)	Time on Concizumab	Thrombotic Event (all non-fatal)	Baseline Thrombotic Risk?*	Concomitant Hemostatic Medication on Day of or Days up to Event Onset?
НА	45–50	2 months	Acute myocardial infarction	Yes	Yes
HBwl	25–30	3 weeks	Renal infarction	Yes	Yes
НА	40–45	3 months	DVT, PE, superficial thrombosis of vein (left elbow region at site of FVIII injection)	Yes	Yes

<sup>\*</sup>One patient (in explorer7) had obesity, hypercholesterolemia, and multiple removals and replacements of a central venous access device. One patient (in explorer8) had obesity, lower leg edema, and hypertension. A second patient in explorer8 had a history of smoking, hypertension with occasional use of ACE inhibitors, increased BP at screening, chronic tooth inflammation followed by extraction, and occasional chest pain for the month preceding the thromboembolism in the other patient.

In March 2020, study was paused for evaluation of trial data and development of mitigation strategy

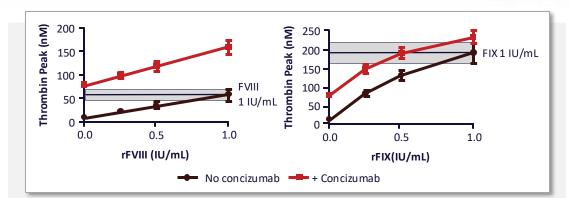
DVT, deep vein thrombosis; PE, pulmonary embolism.

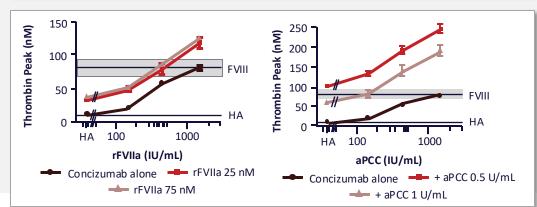


# Concizumab Phase 3 Trials Risk Mitigation



- Assessment included clinical review and nonclinical data
  - Pharmacokinetic profile of patients based on population PK modeling
  - Thrombin generation studies with concomitant FVIII, FIX, FVIIa, and aPCC
- Risk mitigation
  - ELISA-based concizumab dose adjustments
    - Therapeutic: 200–4,000 ng/mL
  - Decreased factor dosing to the lowest approved dose for each product when treating mild/moderate bleeds





aPCC, activated prothrombin complex concentrate; PK, pharmacokinetics.

Kjalke M, et al. J Thromb Haemost. 2021;19(7):1687–1696.

# Fitusiran Thrombotic Events Resulting in Trial Pause



 Evaluation of thrombotic events as of October 2020 leading to trial pause and subsequent mitigation strategy

PwH	Age Range (y)	Medical History/Comments	AT Category	Thrombotic Event
НА	30–40	DVT (not identified at enrollment), T2D, obesity, HCV, tobacco use	<10%	CVA
НА	>60	Well-controlled HIV, HCV, and prostate cancer status post-radical prostatectomy (recent PSA WNL)	<10%	Cerebral infarct
HAwl	20–30	Suspected thrombosis involving a spinal injury	<10%	Spinal vascular disorder
HBwI	20–30	Concomitant use of BPA (rFVIIa) in excess of current bleed management guidelines in fitusiran studies	10%–20%	Atrial thrombosis
НА	20–30	Concomitant use of factor concentrate in excess of current bleed management guidelines (event initially misdiagnosed and treated as a subarachnoid hemorrhage resulting in fatal outcome)	10%–20%	Cerebral venous sinus thrombosis

HAwl/HBwl, hemophilia A/B with inhibitors; HCV, hepatitis C virus; HIV, human immunodeficiency virus;

PSA, prostate-specific antigen; T2D, type 2 diabetes; WNL, within normal limits.



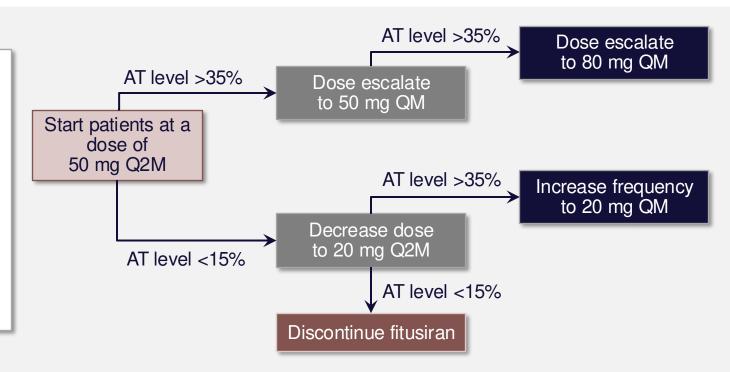


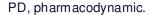
# Fitusiran Revised Dosing Targeting AT Range from ≥15% to ≤35%



Based on fitusiran's MOA and observed AT activity <10% in clinical trial participants with reported vascular thrombotic events, AT activity was evaluated as a potential modifiable target for risk mitigation.

A simulation based on PK/PD modeling identified a dose and regimen targeting AT activity between 15% and 35%.







# Coagulation Assays and Non-Factor Products







## Which clinically-available, standard coagulation tests measure anti-TFPI hemostatic activity?

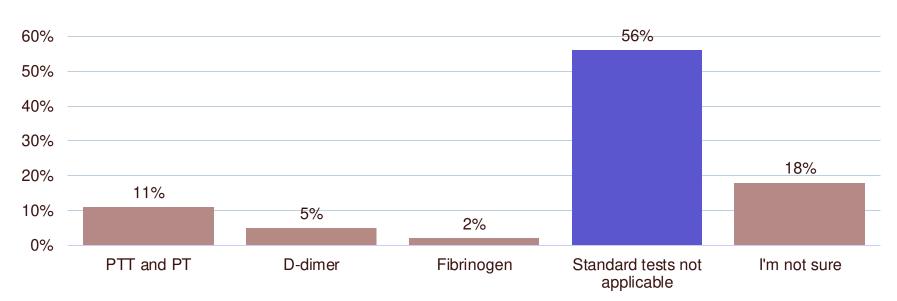
- A. PTT and PT
- B. D-dimer
- C. Fibrinogen
- D. Standard tests not applicable
- E. I'm not sure



## **Audience Response**



## Which clinically-available, standard coagulation tests measure anti-TFPI hemostatic activity?





### **Assays to Assess FVIII Mimetics**



#### **Assay to Determine Drug Is Present**

- aPTT normalized
  - FVIII activity is ↑ ↑ ↑
- Human chromogenic FVIII provides some measure of equivalence
- Bovine chromogenic assays used to
  - Determine level of exogenous FVIII administered
  - Measure FVIII inhibitor
- Drug level

- Clinical monitoring of bleeding events used to assess efficacy
- aPTT prolonged determine if
  - Patient taking drug (t<sub>1/2</sub> is long)
  - Drug is functional
- Human chromogenic FVIII activity and inhibitor to assess for neutralizing antibody



## **Assays to Assess Anti-TFPI Antibodies**

#### **Assay to Determine Drug Is Present**

- Drug levels
  - Concizumab level will be available to direct drug dosing at 1 month
  - Marstacimab level reported in the trial manuscripts

- Clinical monitoring of bleeding events used to assess efficacy
- Assays to determine activity of agent are not standard
  - TFPI measurements
    - Concizumab: ↓ free TFPI
    - Marstacimab: ↑ total TFPI
  - † Thrombin generation
  - ↑ D-dimers/PF 1.2



## **Assays to Assess Fitusiran**



#### **Assay to Determine Drug Is Present**

↓ AT level demonstrates drug activity

- Clinical monitoring of bleeding events used to assess efficacy
- Assays to determine activity of agent are not standard
  - † Thrombin generation



## **Assays to Assess SerpinPC**



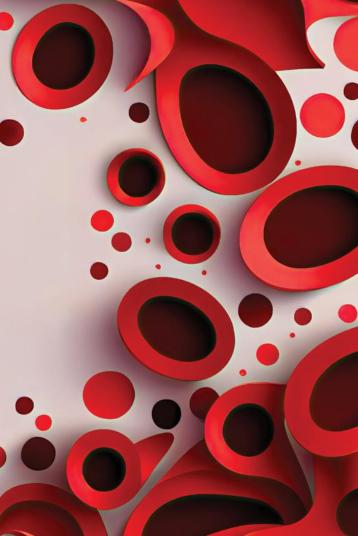
#### **Assay to Determine Drug Is Present**

No standard assay, SerpinPC concentration in clinical trial

- Clinical monitoring of bleeding events used to assess efficacy
- Assays to determine activity of agent are not standard
  - † Thrombin generation











# According to the World Federation of Hemophilia (WFH) Shared Decision Making Guide, what is the recommended first step for patients?

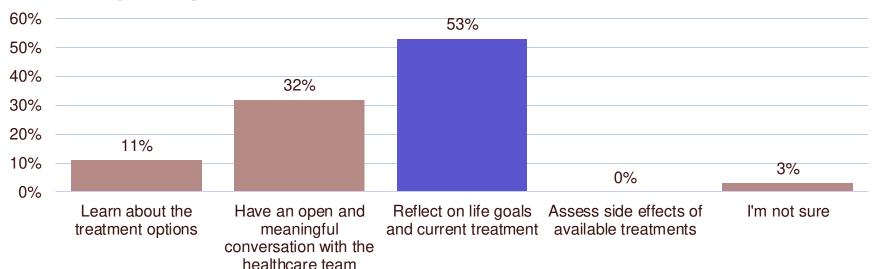
- A. Learn about the treatment options
- B. Have an open and meaningful conversation with the healthcare team
- C. Reflect on life goals and current treatment
- D. Assess side effects of available treatments
- E. I'm not sure



## **Audience Response**



# According to the World Federation of Hemophilia (WFH) Shared Decision-Making Guide, what is the recommended first step for patients?





## What Is Shared Decision Making?



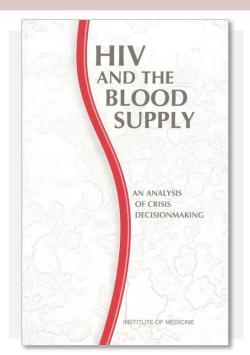
#### A process wherein:

A patient shares with the provider all their aspirations, relevant values, preferences, and goals. A health care provider shares with a patient all relevant information and best scientific evidence on the pros and cons of all potential treatment options.

With this mutual understanding, the patient and provider decide the best course of action.



## SDM Adopted in Hemophilia in 1980s



Blood safety is a shared responsibility of many diverse organizations, including manufacturers, groups such as the NBDF (formerly NHF), and others.

How is medical decision-making shared? The case of haemophilia patients and doctors: the aftermath of the infected blood affair in France

Emmanuelle Fillion

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#### Accepted for publication 2 July 2003

Keywords: AIDS, clinical relationship decision-making, haemophilia, prosecution, sociology

#### Abstract

**Objective** This article looks at how users and doctors in France have rethought the question of shared decision-making in the clinical field of haemophilia following a major crisis – that of the infected blood affair.

 $\begin{tabular}{ll} \textbf{Design} \begin{tabular}{ll} We \begin{tabular}{ll} distance & a qualitative survey based on semi-structured interviews in three regions of France. \end{tabular}$ 

**Setting and participants** The interviews covered 31 clinical doctors of haemophilia and 31 users: 21 adult males with severe haemophilia (21/31), infected (14/21) or not (7/21) with HIV, the infected wife of one of the latter (1/31) and nine parents of young patients with severe haemophilia (9/31), either HIV positive (6/9) or negative (3/9).

NBDF, National Bleeding Disorders Foundation; NHF, National Hemophilia Foundation.

Institute of Medicine Committee to Study HIV Transmission through Blood and Blood Products. Leveton LB, et al, eds. HIV and the Blood Supply: An Analysis of Crisis Decisionmaking. National Academies Press (U.S.). 1995. https://www.ncbi.nlm.nih.gov/books/NBK232417/. Fillion, M. *Health Expect*. 2003;6(3):228–241.



## What Is Shared Decision Making?



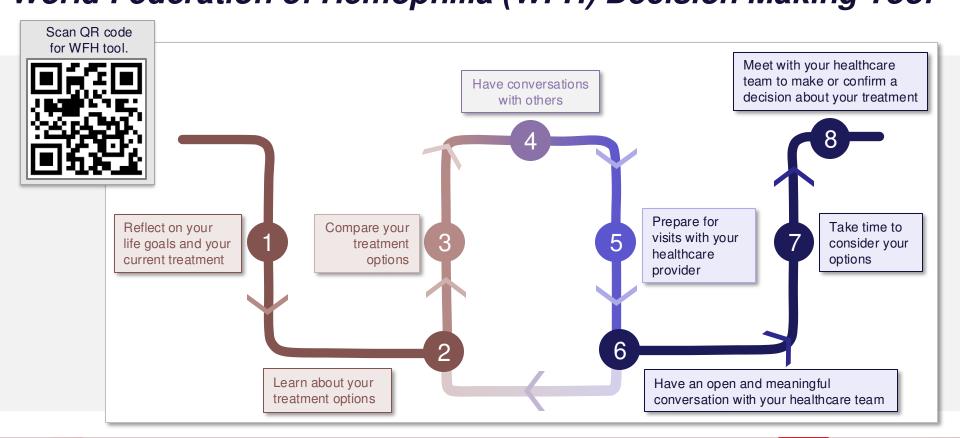
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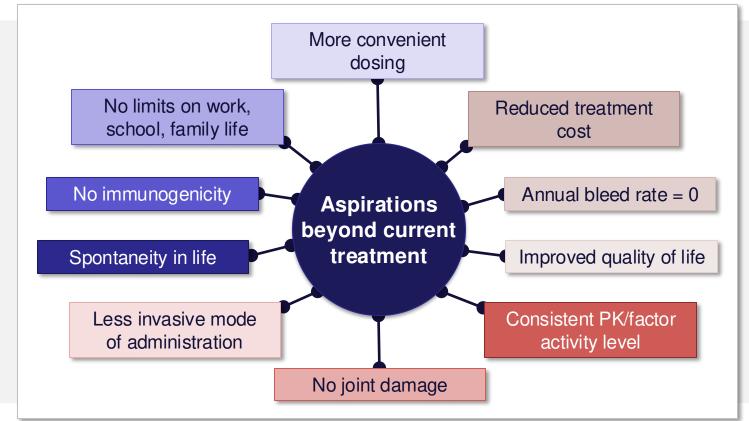
# Step-by-Step Guide to SDM World Federation of Hemophilia (WFH) Decision Making Tool



## **Assess Your Goals and Aspirations**

How would you describe the impact of your hemophilia on obtaining your life goals (goals related to work, education, family, hobbies, etc.)?

Why are you considering a change to your therapy?





## Reflect on Your Life with Hemophilia

Reflect on your life with hemophilia. Your answers will be included in your personalized summary at the end of the tool for you to print and bring to your healthcare team. On a scale of 0 to 100, rate how much you agree with these statements.

- I feel tied to (or constrained by) my hemophilia treatment
  - Managing my hemophilia takes a lot of effort. [0]
  - My hemophilia is always in the back of my mind. (0)
  - I feel adequately protected against bleeds. [0]
  - am concerned about the potential side effects of novel
  - 6. I feel upset about missing significant opportunities because therapies for hemophilia. [0]
  - 7. My hemophilia makes it difficult to keep up a satisfying
  - 8. My hemophilia keeps me from being able to fulfill the roles I expect to be able to do. [0]



## What Is Shared Decision Making?



#### A process wherein:

A patient shares with the provider all their aspirations, relevant values, preferences, and goals. A health care provider shares with a patient all relevant information and best scientific evidence on the pros and cons of all potential treatment options.

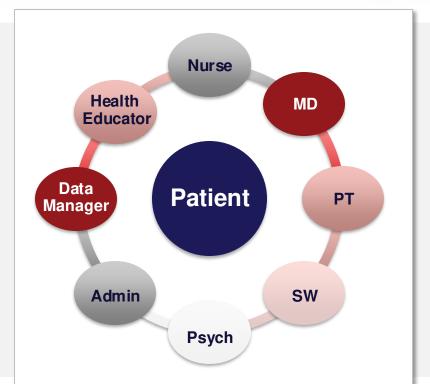
With this mutual understanding, the patient and provider decide the best course of action.



### Importance of Patient Education

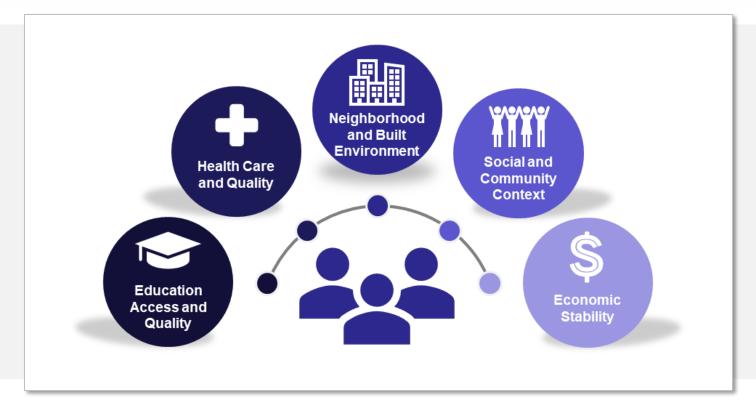


- Involve the multidisciplinary team
- Take into account patient's
  - Development stage
  - Health literacy
  - Cultural background
  - Other social determinants of health (SDoH)





#### **Understand Social Determinants of Health**





## SDoH (...cont'd)



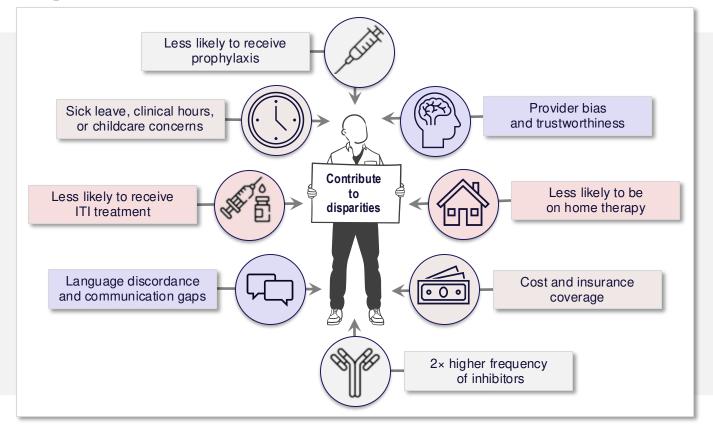
Economic Stability	Neighborhood and Physical Environment	Education	Food	Community and Social Context	Health Care System
Employment	Housing	Literacy	Hunger	Social integration	Health coverage
Income	Transportation	Language	Access to healthy options	Support systems	Provider availability
Expenses	Safety	Early childhood education		Community engagement	Provider linguistic and cultural competency
Debt	Parks	Vocational training		Discrimination	Quality of care
Medical bills	Playgrounds	Higher education		Stress	
Support	Walkability				
	Zip code/ geography				

#### **Health Outcomes**

Mortality, morbidity, life expectancy, health care expenditures, health status, functional limitations



# **Contributors to Racial and Ethnic Disparities** in Hemophilia Care and Outcomes





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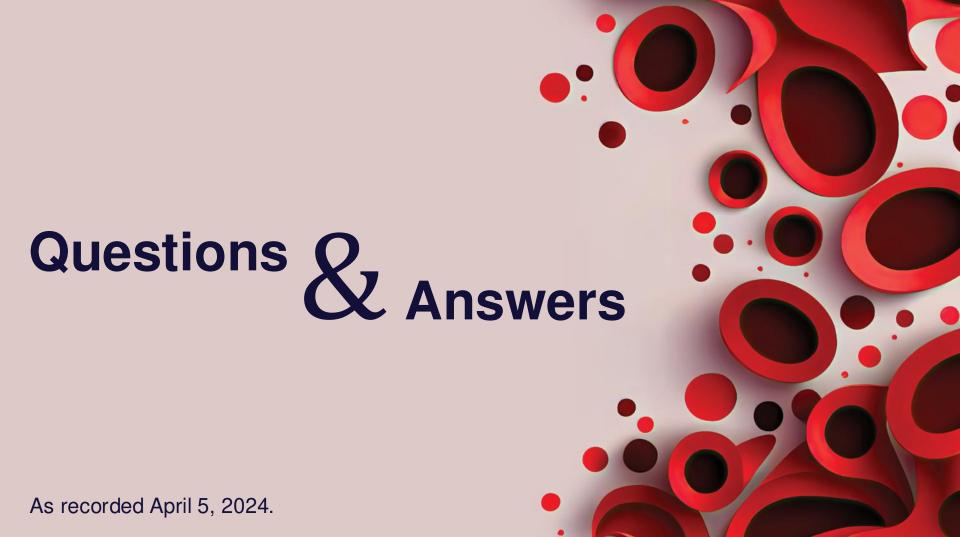


#### A process wherein:

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## Summary



- Stay current with transformational changes in hemophilia management, including FVIIIa mimetics, TFPI inhibitors, ATsiRNA, and APC inhibition
- Where applicable, follow risk mitigation strategies to ensure safe use of novel therapies
- Assess and implement emerging monitoring strategies for nonfactor therapies
- Implement shared decision making with patients to improve quality of care, adherence to therapies, and outcomes



