

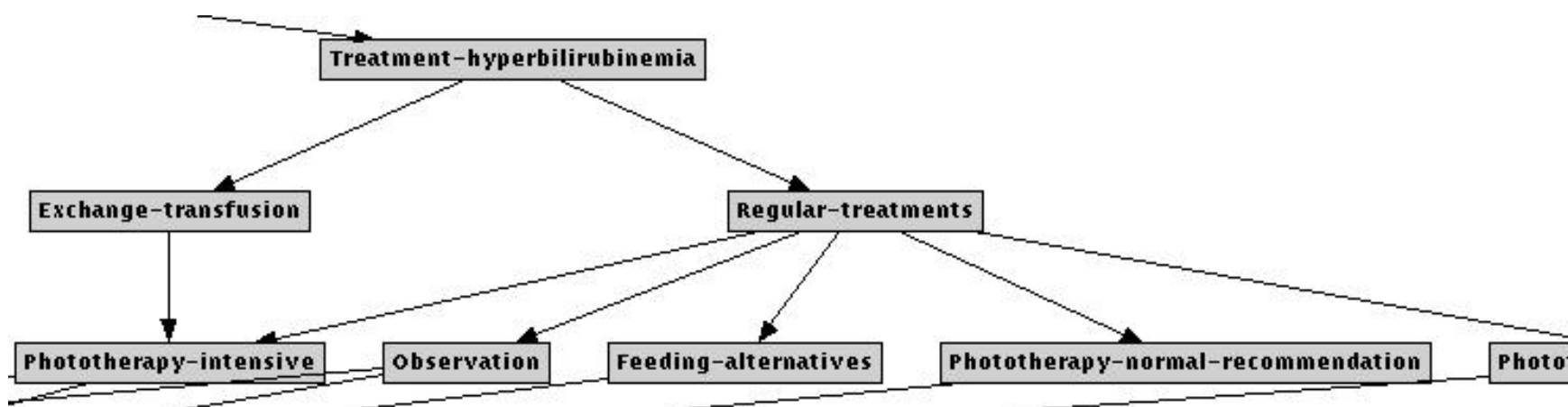
Report on KIV verification of jaundice protocol

Plan

- The jaundice protocol in KIV
- Verification efforts
- Some conclusions

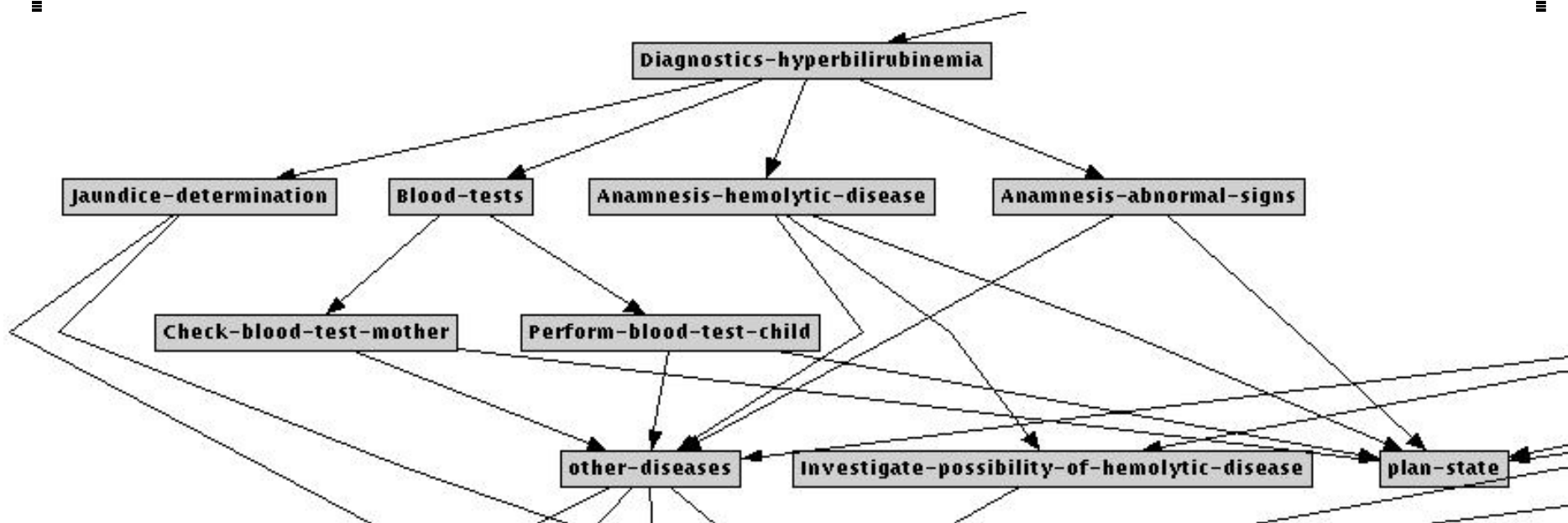
The jaundice protocol in KIV

- The treatment part:



The jaundice protocol in KIV (cont.)

- The diagnosis part:



The jaundice protocol in KIV (cont.)

- Latest changes:
 - new translation for “try all” plans
(type=sequentially + wait-for one + wait-for-optional-subplans=yes)
 - new translation for filter preconditions without time annotations
 - new record data type: `patient-data`
 - new data types for unknown values

The jaundice protocol in KIV (cont.)

- The top-level plan:

The jaundice protocol in KIV (cont.)

– The top-level plan:

PLAN Hyperbilirubinemia

CONDITIONS

abort-conditions: possibility-of-hemolytic-disease=true

PLAN BODY

do unordered, wait-for Diagnosis+Treatment-hyperbilirubinemia

Check-for-rapid-TSB-increase

Check-for-jaundice>2-weeks

Check-for-jaundice>3-weeks

Diagnosis+Treatment-hyperbilirubinemia

The jaundice protocol in KIV (cont.)

– The top-level plan:

```
Hyperbilirubinemia#(VAR patient-data,time)
BEGIN
  VAR  var-possibility-of-hemolytic-disease = [?],
        var-possibility-of-cholestatic-disease = [?],
        Diagnostics+Treatment-hyperbilirubinemia-st = [?] IN
  BEGIN
    PBREAK
    BEGIN
      Check-for-rapid-TSB-increase#(; patient-data,time,
        var-possibility-of-hemolytic-disease)
      ||s Check-for-jaundice-after-2-weeks#(; patient-data,time,
        var-possibility-of-cholestatic-disease)
      ||s Check-for-jaundice-after-3-weeks#(; time,
        var-possibility-of-cholestatic-disease)
      ||s Diagnostics+Treatment-hyperbilirubinemia#(; patient-data,
        time,Diagnostics+Treatment-hyperbilirubinemia-st)
    END
  IF Diagnostics+Treatment-hyperbilirubinemia-st = completed
  V var-possibility-of-hemolytic-disease = true
END
```

The jaundice protocol in KIV (cont.)

- Example: Blood-tests plan

The jaundice protocol in KIV (cont.)

- Example: Blood-tests plan

PLAN Blood-tests

PLAN BODY

do sequentially, wait-for-optional-subplans = yes, wait-for one
 Check-blood-test-mother
 Perform-blood-test-child

PLAN Check-blood-test-mother

CONDITIONS

filter-preconditions: known(blo-mother) **and** known(rhe-mother)
 and known(ant-mother)

...

The jaundice protocol in KIV (cont.)

- Example: Blood-tests plan

```
Blood-tests#(VAR patient-data,time,pathologic-reason,Blood-tests-st)
BEGIN
  VAR  Check-blood-test-mother-st = inactive,
        Perform-blood-test-child-st = inactive IN
  BEGIN
    PBREAK
    BEGIN
      Check-blood-test-mother#(; patient-data,time,
        Check-blood-test-mother-st);
      Perform-blood-test-child#(; patient-data,time,
        pathologic-reason,Perform-blood-test-child-st)
    END
    IF    Check-blood-test-mother-st.failed
          ^ Perform-blood-test-child-st.failed
        v Check-blood-test-mother-state = completed
          ^ Perform-blood-test-child-state.terminated
        v Check-blood-test-mother-state.terminated
          ^ Perform-blood-test-child-state = completed;
    ...
  END
END
```

The jaundice protocol in KIV (cont.)

- Example: Blood-tests plan (cont.)

The jaundice protocol in KIV (cont.)

- Example: Blood-tests plan (cont.)

```
Check-blood-test-mother#(VAR patient-data,time,  
    Check-blood-test-mother-st)  
BEGIN  
  IF patient-data.blo-mother ≠ ⊥ ∧ patient-data.rhe-mother ≠ ⊥  
    ∧ patient-data.ant-mother ≠ ⊥  
  THEN  
    BEGIN  
      IF consider-holding-cord-blood(patient-data.blo-mother.value,  
        patient-data.rhe-mother.value,  
        patient-data.ant-mother.value)  
      THEN Consider-holding-cord-blood#(; time);  
      Check-blood-test-mother-state := completed  
    END  
  ELSE  
    Check-blood-test-mother-state := rejected  
  END  
END
```

Verification efforts

- Termination of (sub)plans
 - Finished:
 - Observation
 - Phototherapy-intensive
 - Finished, except for user-performed plans:
 - Check-blood-test-mother (Aberdeen)
 - Partial, easy (?):
 - Blood-tests (A'dam → bug)
 - Diagnostics-hyperbilirubinemia (A'dam)
 - Phototherapy-normal-prescription (A'dam)

Verification efforts

- Termination of (sub)plans (cont.)
 - Partial, difficult:
 - Exchange-transfusion (||s–Augsburg)
 - Feeding-alternatives (√–Augsburg)
 - Perform-blood-test-child (||a–Augsburg)
 - Phototherapy-normal-recommendation (√–Augsburg),

Some conclusions

- Current state:
 - formalisation of jaundice is complete
 - verification of termination is in progress:
 - depends on development/debugging of proof support for Asbru constructs
 - but seems feasible (A'dam's point of view)

Some conclusions (cont.)

- Proofs:
 - some (termination) proofs “look alike”
 - a high degree of automation is possible
- Proof support:
 - necessary KIV extensions were underestimated (additional workpackage!) → do we need a policy to decide on the next extensions? (e.g. property/proof driven)